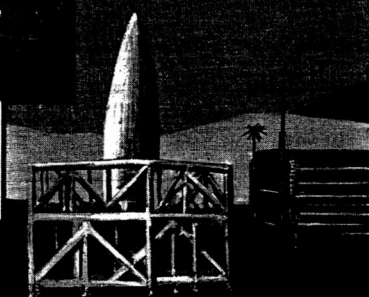
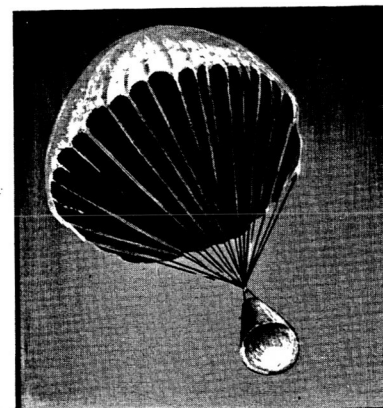
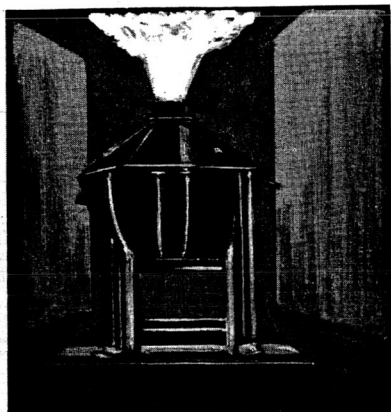


FINAL TEST REPORT

NASA CR-66487

RE-ENTRY "F"
NOSE VIBRATION
AND SHOCK TEST



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LANGLEY STATION
HAMPTON, VIRGINIA
M. MOST

JULY, 1967

TEST AND
EVALUATION
ENGINEERING

RE-ENTRY
SYSTEMS
DEPARTMENT



GENERAL
ELECTRIC

FINAL REPORT

NAS-6039

FOR

RE-ENTRY "F" NOSE VIBRATION AND SHOCK TEST

Prepared by:

M. Most

Date

7/7/67

M. Most, Test Conductor
Mechanical Systems Laboratory

Approved by:

L. Rosenthal

Date

7/7/67

L. Rosenthal, Manager
Mechanical Systems Laboratory

Concurred by:

C. R. Seyler

Date

7/7/67

C. R. Seyler, PTE
Experimental Engineering

Distribution of this report is provided in the interest of
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resides in the author or organization that prepared it.

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1.0 INTRODUCTION

A series of tests were performed on Re-Entry "F" Nose (GE SK56163-426-Sheet 2, Rev. M) to determine if it would withstand the predicted vibration and shock environments. The nose was mounted in a manner which simulates actual spacecraft mounting at station 8.6. Vibration surveys were made with input in the roll axis and one lateral axis direction. Shock tests were performed with input in the roll axis only. Since input levels specified by NASA Langly Research Center's Statement of Work are applied at station 156, input levels at station 8.6 were based on analytical predictions.

2.0 SUMMARY OF RESULTS

2.1 Low level sinusoidal vibration surveys were performed on two noses. Lateral and axial excitations produced system resonances and nose tip responses as shown in Table below:

NOSE #1

NOSE #2

LATERAL SINUSOIDAL SURVEY

Resonant Frequency cps	Input Acceleration G, o-p	Output Acceleration G, o-p	Resonant Frequency cps	Input Acceleration G, o-p	Output Acceleration G, o-p
230	1.0	70.0	140	1.0	20.0
750	1.0	90.0	460	1.0	60.0
			820	1.0	52.0

AXIAL SINUSOIDAL SURVEY

Resonant Frequency cps	Input Acceleration G, o-p	Output Acceleration G, o-p	Resonant Frequency cps	Input Acceleration G, o-p	Output Acceleration G, o-p
1500	1.0	37.0	1500	1.0	24.0
1900	1.0	32.0	1700	1.0	18.0

Differences in results obtained are assumed to be caused by nose assembly preload variations, despite the fact that 0.1 inch compression of Belleville washer stack was correct on both noses.

- 2.2 Nose No. 1 was subjected to flight assurance and qualification vibration and shock environments. Nose No. 2 received vibration tests only. Visual and x-ray inspection showed no change in the condition of either nose due to testing.

3.0 TEST OBJECTIVES

- 3.1 To determine the fundamental frequency of the nose assembly.
- 3.2 To determine the nose structural integrity when exposed to the predicted vibration qualification environment.
- 3.3 To determine the nose structural integrity when exposed to the predicted shock qualification environment.

4.0 TEST SPECIMEN

4.1 Description

Re-Entry "F" Nose Assembly as identified by GE Drawing SK56163-426-Sheet 2, Revision M.

4.1.1 Nose No. 1 - Deviated from specifications insofar as thermal sensor extended too far into ATJ Graphite. It was felt that this deviation would not affect the test results, and was therefore used to gain additional information in both shock and vibration.

4.1.2 Nose No. 2 - Full scale nose accepted as meeting specification, subsequently used for Malta Thermal Tests.

4.2 Handling

The nose was attached to the vibration fixture and torqued to 0.1 inch compression of the Belleville washer stack. At this point, x-rays were made every 45° to determine if any defects existed in the specimen. Prior to testing, thermocouples were tested for continuity. Photos were taken of test set-up and accelerometer locations. Upon completion of testing thermocouples were again tested for continuity and the nose re-examined as above to determine the effects of testing.

4.3 Disposition After Test

The specimen was delivered to Experimental Engineering for further testing.

4.4 Security Classification

No special security classification was involved in this test.

5.0 DATA ACQUISITION

5.1 Data Recording

All test data was recorded on magnetic data tape. The acceleration response was measured using a crystal type accelerometer.

5.2 Data Reduction

The recorded sinusoidal accelerometer output was presented in X-Y plots of G's o to peak vs excitation frequency. The recorded random accelerometer output was reduced to g^2/cps vs frequency plots.

5.3 Shock inputs were presented as acceleration vs time plots using an oscilloscope and polaroid camera.

6.0 TEST DESIGN CONSIDERATIONS

6.1 Fixture Design

Vibration fixture was designed to simulated actual clearances and attitude that exists on prime installation. Test fixture resonant frequency is calculated at well above 2000 cps, the upper test limit.

6.2 Environmental Testing

All testing was performed at ambient temperature and pressure.

7.0 INSTRUMENTATION

7.1 Accelerometers

7.1.1 The nose accelerometer was a Wilcoxon Sub-Miniature accelerometer, Model 127, weighing 1.5 grams. It has a frequency response of $\pm 1\text{db}$ from 10 to 20000 cps and range from 0.001g to 500g.

7.1.2 Input accelerometers were Endevco type 2272 mounted in triaxial configuration. Along with its associated recording equipment, its frequency response is $\pm 2.5\%$ within the range of 10 to 2000 cps.

7.2 Recording and Measuring Equipment

7.2.1 Accelerometer outputs were recorded on a Sangamo 472 tape recorder.

7.2.2 A Spectral Dynamics Mechanical Impedance Measuring System, Model SD 1002A-23 was used for power spectral density analysis.

7.3 Calibration

Accelerometers were calibrated prior to installation on test hardware. They were compared to an accelerometer traceable to the National Bureau of Standards.

7.4 Accelerometer Locations

7.4.1 The nose response accelerometer was bonded to an adapter c contoured to fit the nose tip using "Eastman 910 Cement." The adapter in turn was attached to the nose tip using "3M Co. Tedlar Tape" to prevent damage to the nose material. A response check was made on a tape interface mounted directly on the exciter table. Comparison on the response between the taped on accelerometer, and a bolted Endevco 2213 showed little difference. The results are shown plotted in the Appendix.

7.4.2 Input accelerometers were bolted to the test fixture at station 8.6 as shown in Appendix

8.0 TEST EQUIPMENT

8.1 Vibration Exciter

8.1.1 MB-C126 Electrodynamic Vibration Exciter was used for lateral axis testing on Nose No. 1.

8.1.2 MB-C50 Electrodynamic Vibration Exciter was used for axial testing on Nose No. 1 and 2 as well as lateral axis testing on Nose No. 2.

8.2 Shock Machine

8.2.1 Shock tests were performed on Avco SM 110 Shock Machine.

8.3 Test Fixture

Test fixture shown in Sketch SK 56130-995 was used for vibration and shock tests.

9.0 TEST FACILITY

Testing was performed at General Electric RSD, 3198 Chestnut Street, Philadelphia, Pa.

10.0 TEST PROCEDURE

10.1 Prior to and after assembling nose to fixture, x-rays were taken to document the condition of the nose and thermal sensor locations.

10.2 Prior to testing thermocouples were tested for continuity.

10.3 Lateral and Roll axis constant acceleration sine survey was performed at 1.0G peak from 5-2000 cps at a sweep rate of one octave per minute. Data was recorded and critical frequencies and accelerations noted.

10.4 Nose was subjected to the following Qualification and Flight Assurance Tests.

<u>Axis</u>	<u>Excitation</u>	<u>Sweep Rate/Duration</u>
Roll	Sine Flight Assurance	4 octaves/min
	Sine Qualification	
Roll	Random Flight Assurance	1 min
	Random Qualification	2 min
Lateral	Random Flight Assurance	1 min
	Random Qualification	2 min

In addition to the above a special sinusoidal sweep was performed in the roll axis with inputs as follows:

Flight Assurance - .012 inches constant double amplitude from 50-70 cps, 12 seconds duration

Qualification - .018 inches constant double amplitude from 50-70 cps, 24 seconds duration.

10.4 (cont.)

Random vibration tests were performed with inputs as close to the predicted levels within the capability of the test equipment. Equalization was performed at 1.5G RMS to minimize fatiguing the specimen, and input was within +3 db of specifications. Final playback in data processing utilized 5 cps filter from 5-100 cps, and 20 cps filter from 100-2000 cps.

10.5 Upon completion of vibration tests, x-rays were again taken and thermocouple continuity was checked.

10.6 The above was repeated for Nose No. 2.

10.7 Nose No. 1 was subjected to the following shock environments:

Flight Assurance: $\frac{1}{2}$ sine pulse, 10-15 millisecond duration
23.0G peak amplitude, applied 3 times
along roll axis.

Qualification: $\frac{1}{2}$ sine pulse, 10-15 millisecond duration
35.0G peak amplitude, applied 3 times
along roll axis.

10.8 Upon completion of shock tests, X-rays were taken and thermocouple continuity checked.

11.0 DETAILED TEST RESULTS AND CONCLUSIONS

11.1 While nose tip response accelerations seem extremely high compared to input, it must be remembered that actual displacement amplitude at the frequencies involved is quite small. It is therefore felt that due to the length of the system and tightness conditions on the nose assembly, actual stresses are insignificant. This is verified further insofar as flight assurance and qualification environments had no affect on the condition of both noses.

11.2 Thermocouple resistance checks before and after testing showed no change.

12.0 RESPONSIBILITIES

- 12.1 The Test Conductor was supplied by Mechanical Systems Laboratory and was M. Most.
- 12.2 The Instrumentation and Support Laboratory installed the accelerometers, set up the instrumentation recording system and recorded the data during portions of the test. They provided playback facilities, aided in data reduction and provided inputs for the final report.
- 12.3 QC&T provided test facility and operators as well as instrumentation support for portions of the test.

13.0 APPENDIX

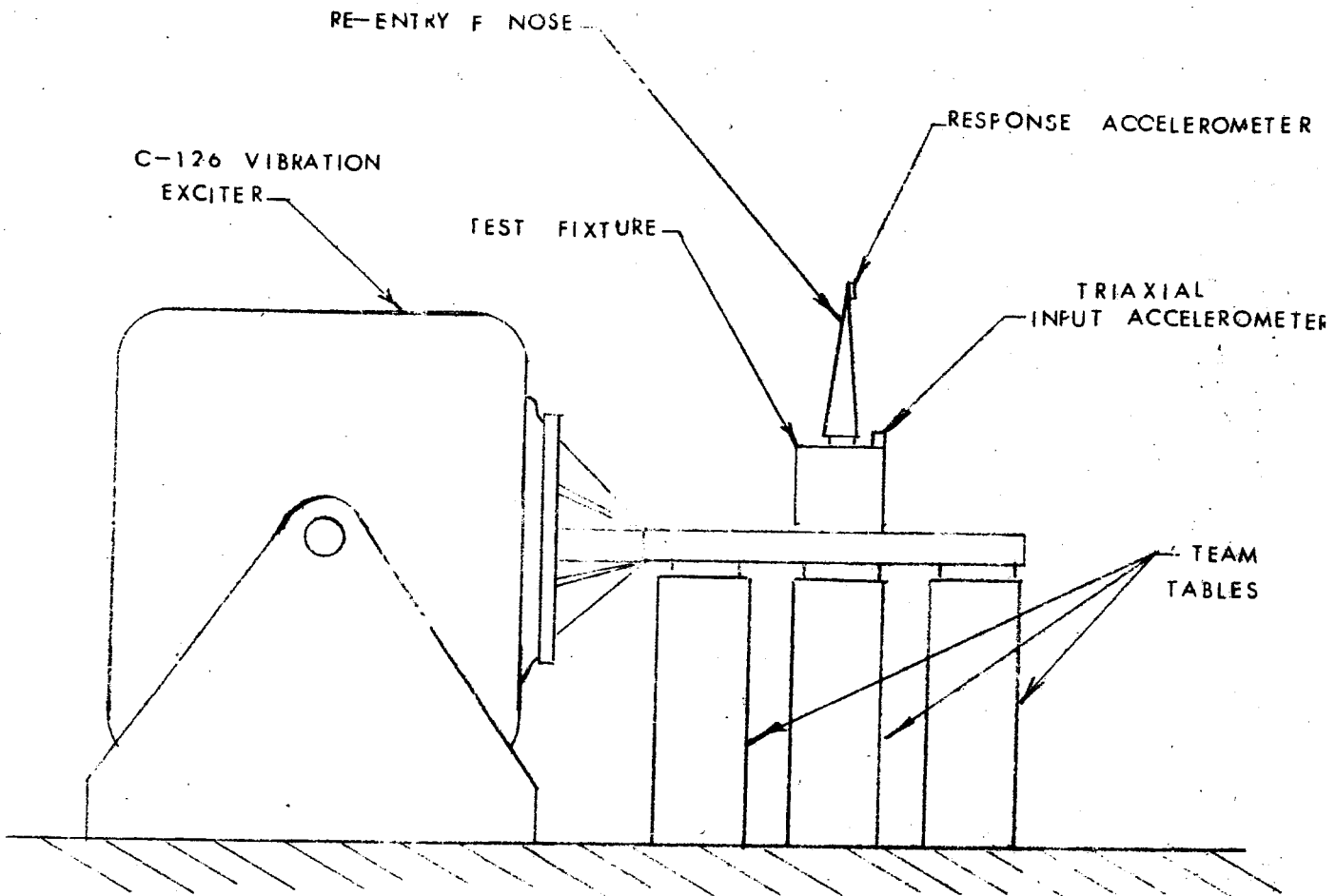


FIGURE 1 LATERAL AXIS VIBRATION SET-UP
NOSE NO. 1

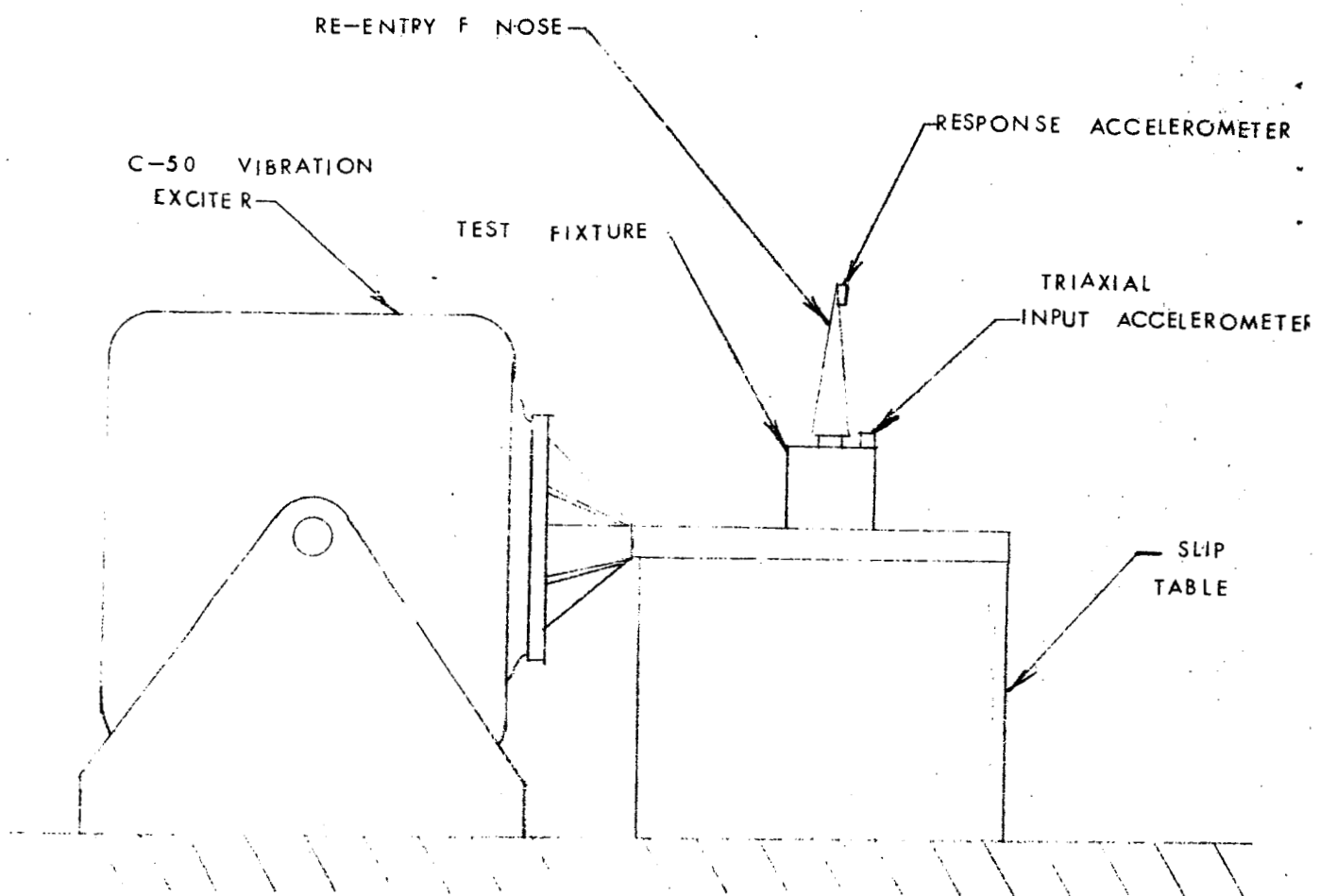
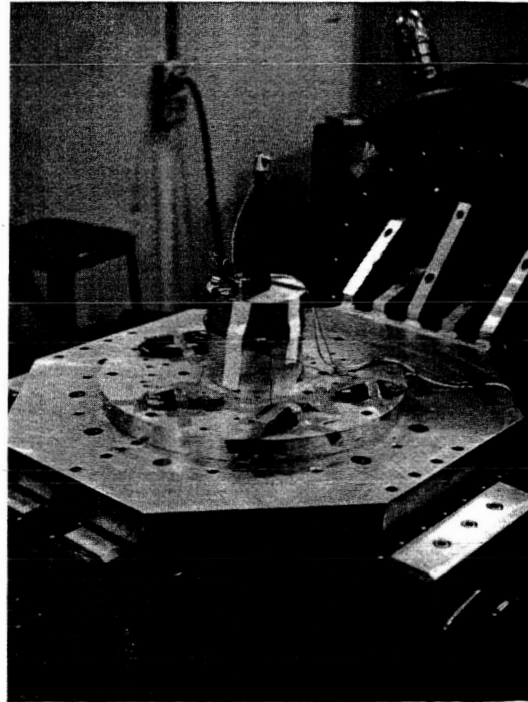
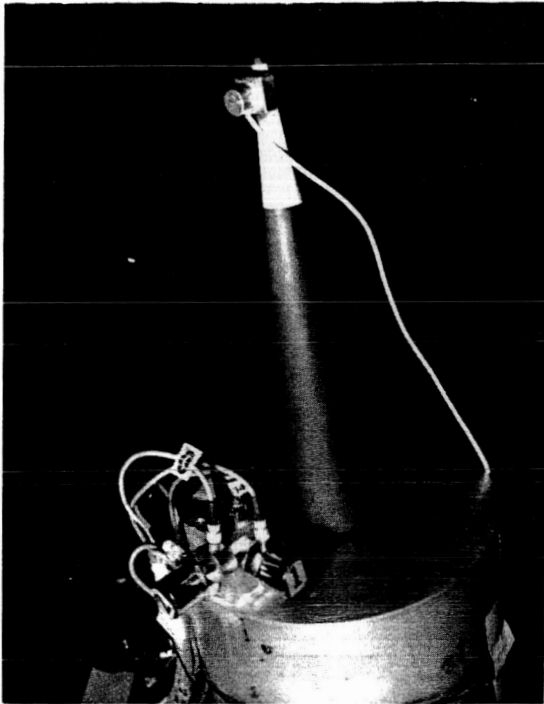


FIGURE 2 LATERAL AXIS VIBRATION SET-UP

NOSE NO. 2



LATERAL AXIS VIBRATION TEST
SET UP

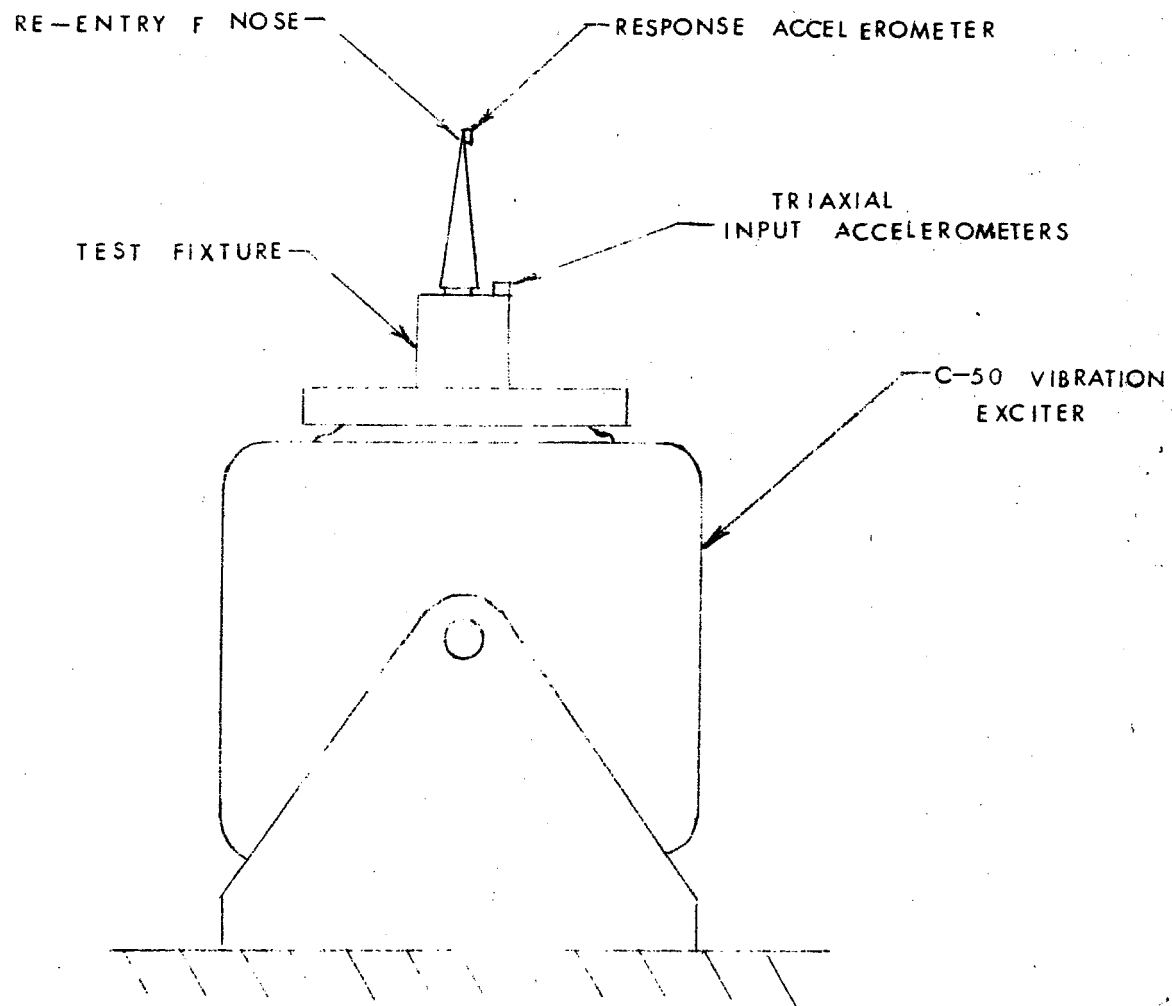
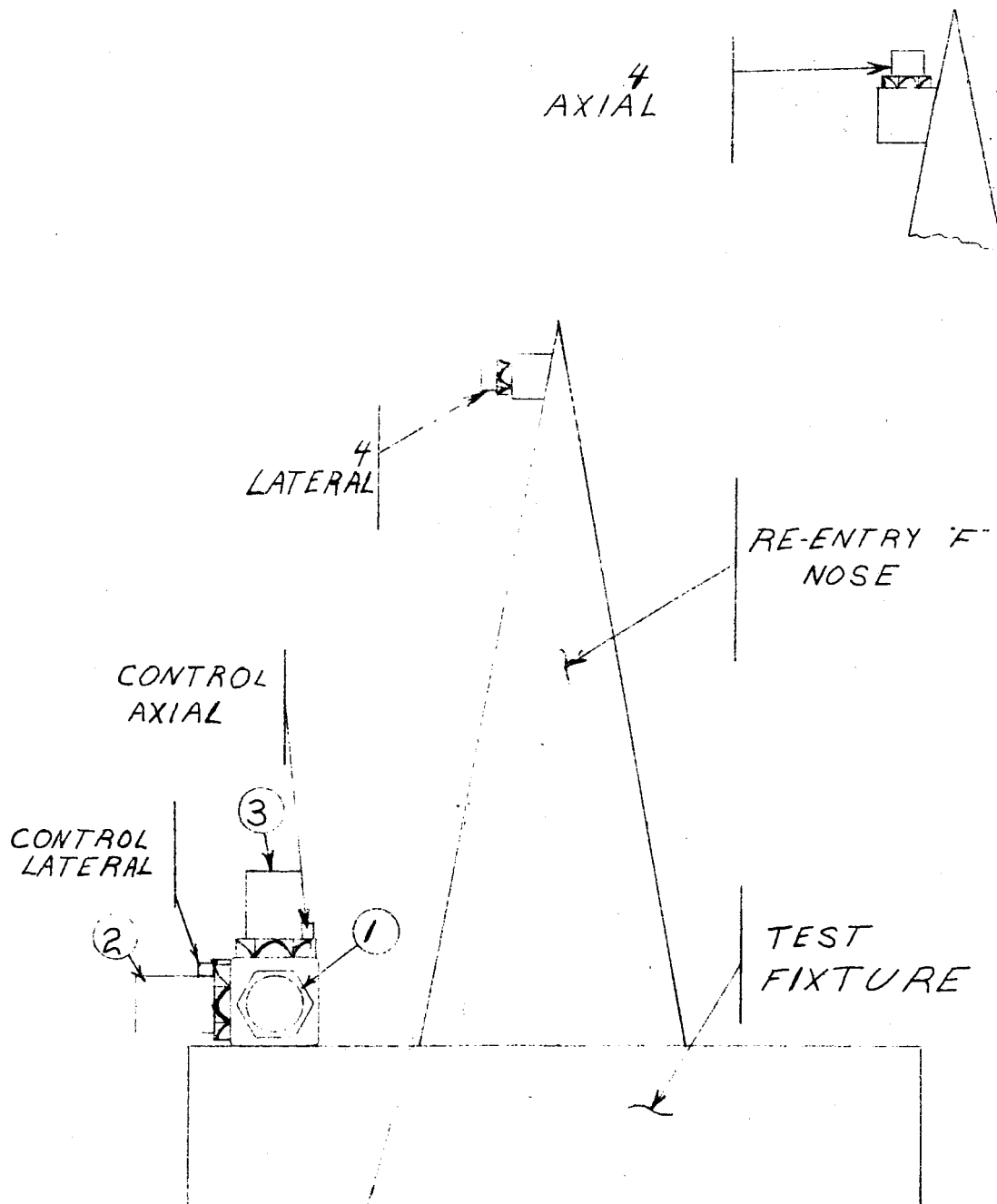


FIGURE 3 - ROLL AXIS VIBRATION SET-UP
NOSE 1 AND 2



AXIAL AXIS VIBRATION TEST
SET UP

RE-ENTRY "F" NOSE VIBRATION ACCELEROMETER LOCATIONS

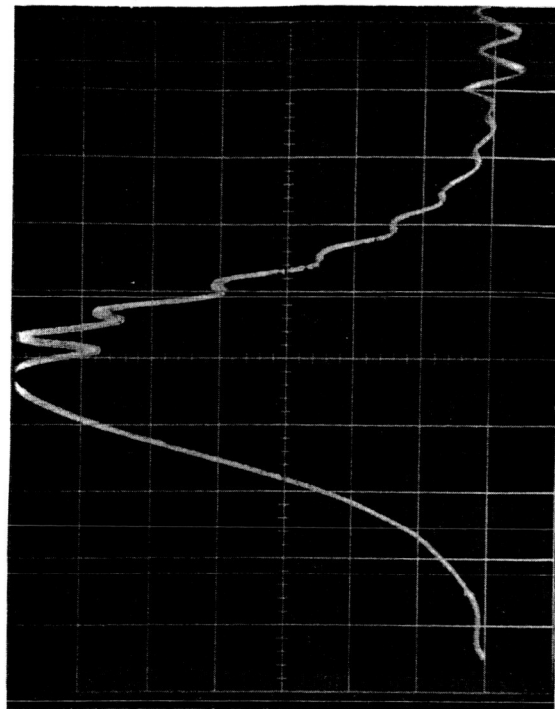




3.43 g/div

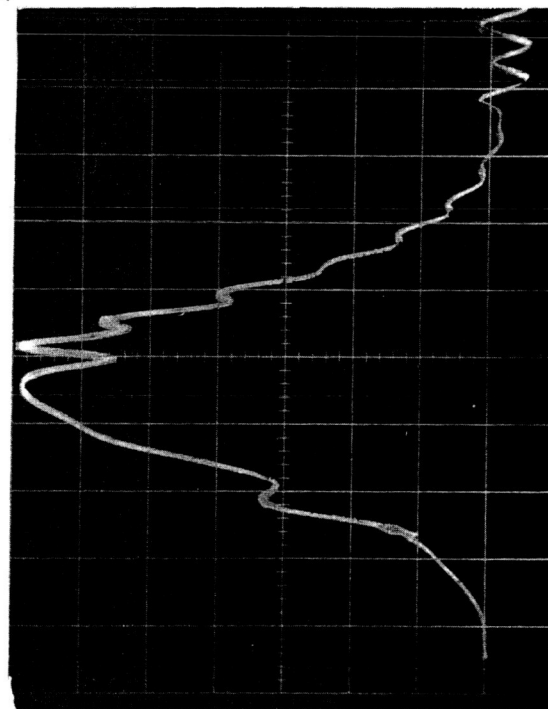
ACCELERATION - G

TIME MILLISECONDS - 2.0 MILES/DIV



ACCELERATION-G
3.43 g/div

TIME MILLISECONDS - 2.0 MILES/DIV



ACCELERATION-G
3.43 g/div

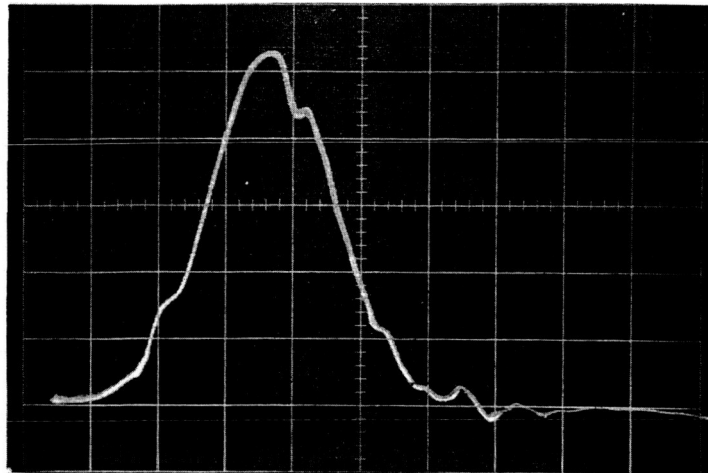
TIME MILLISECONDS - 2.0 MILES/DIV

RE-ENTRY-'F' SPACECRAFT NOSE
SHOCK TEST - FLIGHT ASSURANCE INPUT

RE-ENTRY "F" SPACECRAT- NOSE

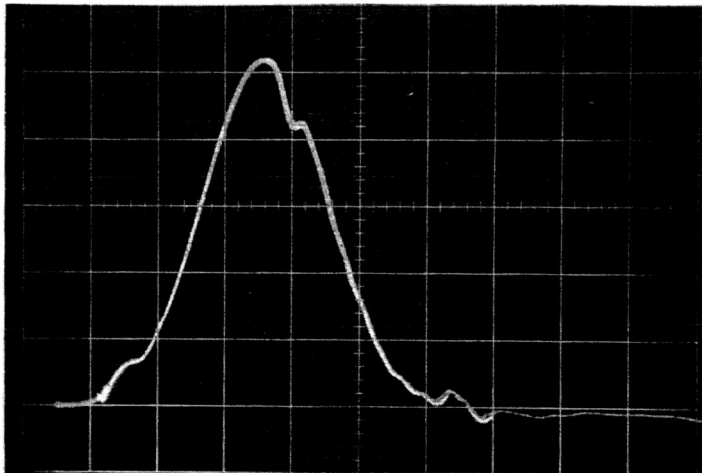
SHOCK TEST - QUALIFICATION INPUT

ACCELERATION - G
6.85 G/DIV.



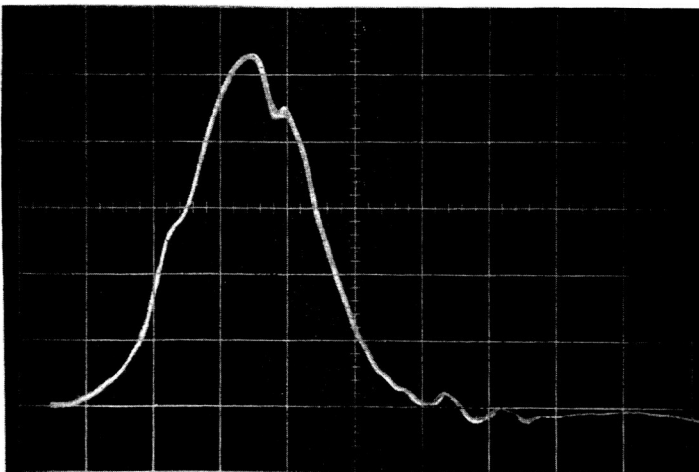
TIME MILLISECONDS - 2.0 MILS/DIV.

ACCELERATION - G
6.85 G/DIV.



TIME MILLISECONDS - 2.0 MILS./DIV.

ACCELERATION - G
6.85 G/DIV.

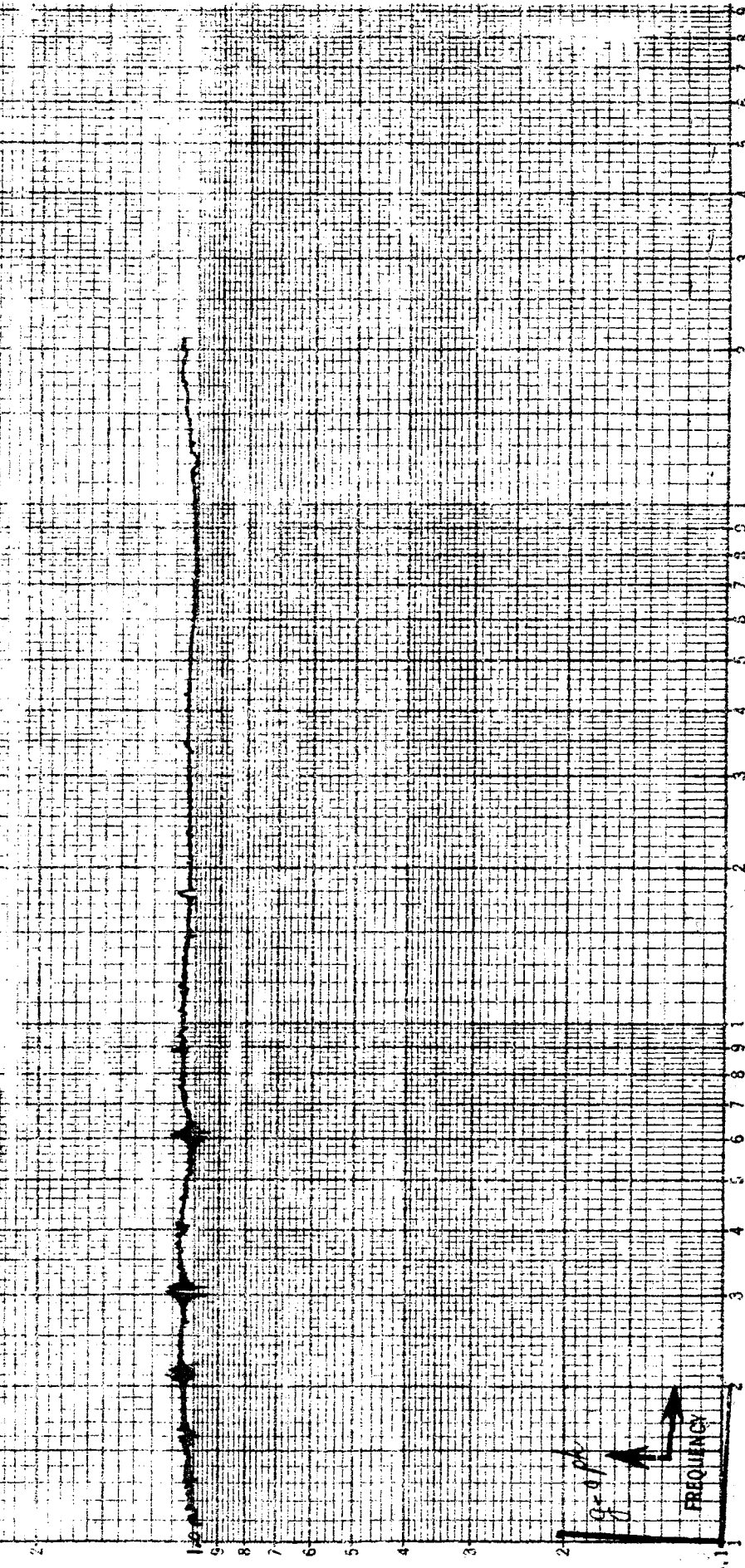


TIME MILLISECONDS - 2.0 MILS./DIV.

10 9 8 7 6 5 4 3 2 1 0 100 9 8 7 6 5 4 3 2 1 0 100 9 8 7 6 5 4 3 2 1 0

Re-Entry F
Nose Vibration
Nose No1
AXIAL SINE SURVEY

ITEM: NOSE
PWC: SX-5111-926 L. NO: 10358
S/N: E-04 PROG: 149
CHANNEL: CONTINUED
DIRECTION: RAIR/ NACE: 837
DATE: 5-9-67 TECH: J. S. M. - 60
Y AXIS CAL: Out 11.0, 10.5
X AXIS CAL: 10 - 2000 Hz



X AXIS CAL: 5-2020/23

AXIAL SINE SURVEY



9c-pk

FREQUENCIES

Re-Entry F
Nose Vibration
Nose No. 1

AXIAL SINE SURVEY

ITEM: 4055

DWG. SK 56143-426 L. NO. 8758

S/N: EDJ PRG: KNC

CHANNEL: #1 40" PITCH SURVEY

DIRECTION: AXIAL MAGN: CSD

DATE: 5-11-67 TECH: DE Menden

Y AXIS CAL: 1.87 KGH

X AXIS CAL: 5.3 KGH

W. AXIS CAL: 5.3 KGH

9-07K

FREQUENCY

ion

SECRET

ITEM: 105#

DWG: SK 6763-426 L. NO 8725

S/N: 100

PROG: 100

CHANNEL: 2

DATE: 10/10/67

TIME: 18:00

LOC: 100

COORD: 100

REMARKS: 100

100

FREQUENCY

ITEM: NOISE

DWG. NO. 56113-426-1. NO. 8758

S/N: 2711

CHANNEL: #3 90° AXIAL SURVEY

DIRECTION: AXIAL MAG: 160

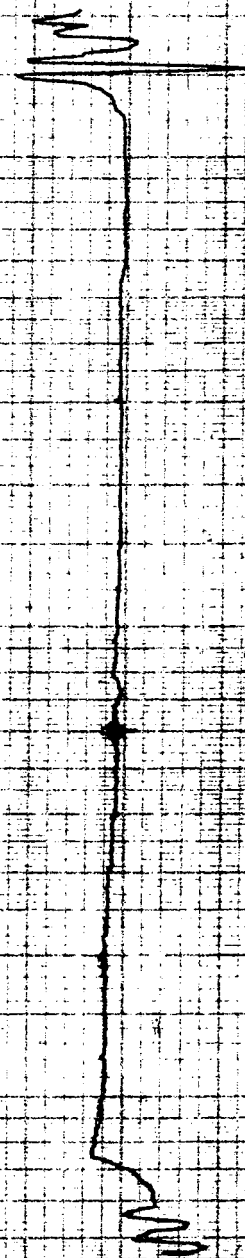
DATE: 5-10-67 TECH: GEMMONT

Y AXIS CAL: 1.81 in/H

X AXIS CAL: 5-2800 Hz

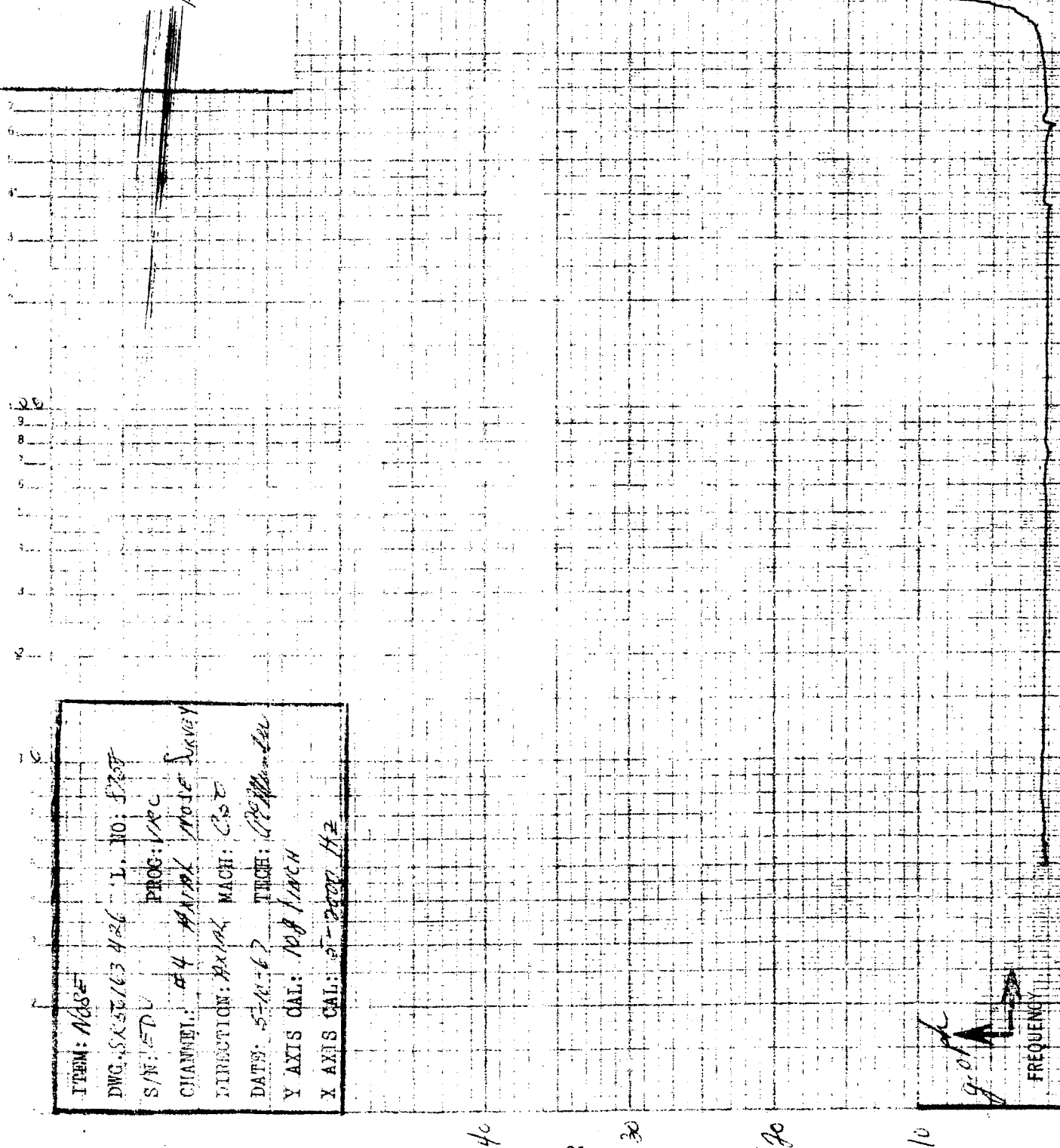
Re-Entry F
Nose Vibration
Nose No1

AXIAL SINE SURVEY



AXIAL SINE SURVEY

I ITEM: A885
DWG. SK 50163 HZ L. NO: 5307
S/N: EPU PROG: APC
CHANNEL: #4 APCXK Morse Navy
DIRECTION: APCXK MACH: CSD
DATE: 5-11-67 TECH: GPC/Monster
Y AXIS CAL: 108 INCH
X AXIS CAL: 51-2000 HZ



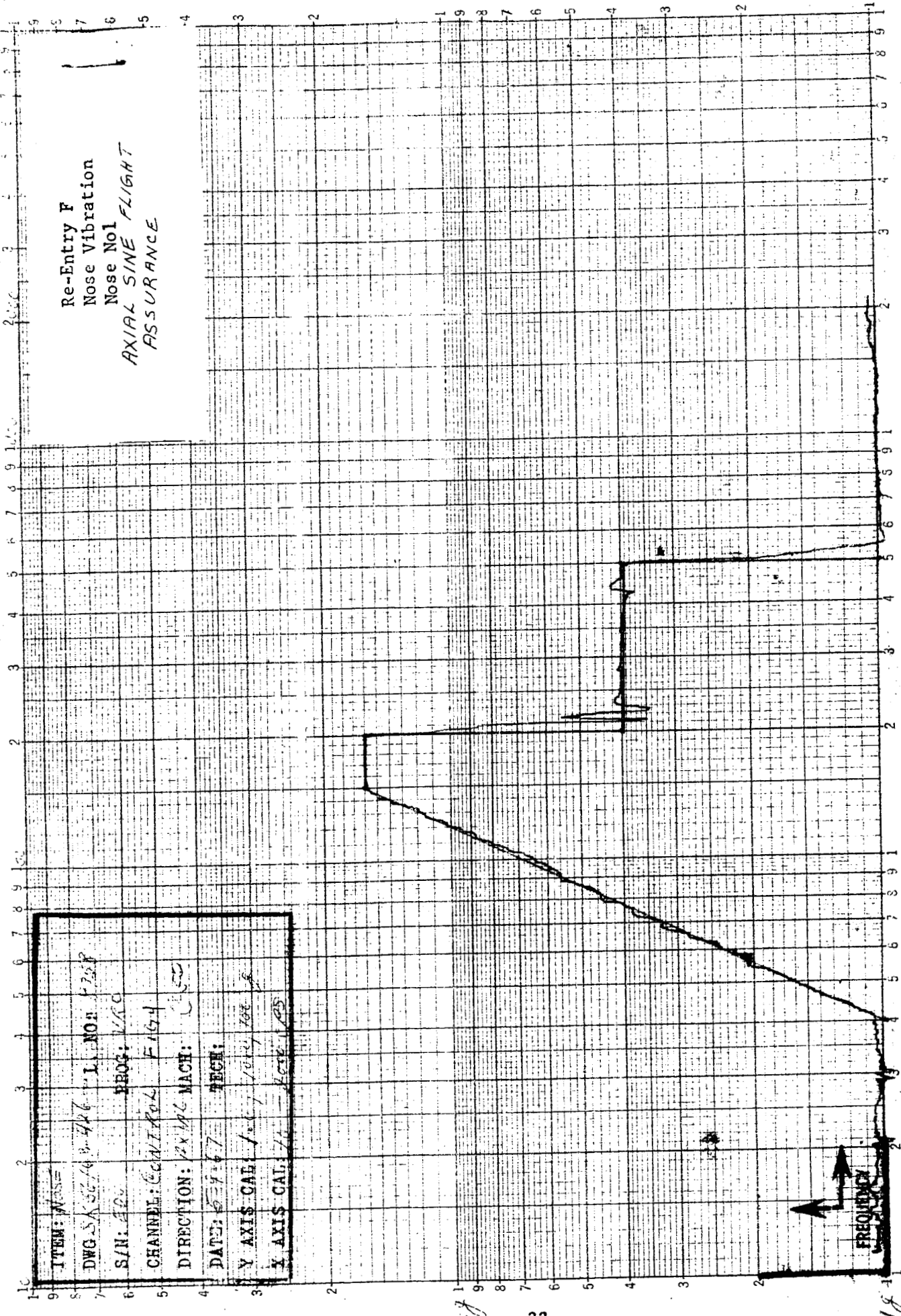
46 7323

LOGARITHMIC

KEUFFEL & ESSER CO

Re-Entry F
Nose Vibration
Nose No1
AXIAL SINE FLIGHT
ASSURANCE

ITEM: WASS
DWG: SK 52/4 3-426 L. NO: 5728
S/N: 426 PROG: VSC
CHANNEL: CCH/ITOL FIG 4
DIRECTION: 2x/426 MACH: 0.55
DATE: 8-9-67 TECH:
Y AXIS CAL: 1.00, 10.0, 100.0
X AXIS CAL: 1.0, 10.0, 100.0



ITEM: NOSE

DWG. S/S 50163-426 L. NO: 8728

S/N: EDC PROG: VRC

CHANNEL: 1 90° PITCH FIG. 4

DIRECTION: AXIAL MACH: C50

DATE: 5-13-67 TECH: G.E. Harrison

Y AXIS CAL: 1.91 INCH

X AXIS CAL: 5-2477 HZ

Re-Entry F
Nose Vibration
Nose No1

AXIAL SINE FLIGHT
ASSURANCE



ITEM: NOSE

DWG: SK54 163-426 L. NO: 8753

S/N: 600 PROJ: VRC

CHANNEL: 42, 90° YAW FLG 4

DIRECTION: AXIAL MAT: C50

DATE: 5-13-67 TEST: R. E. Munkel

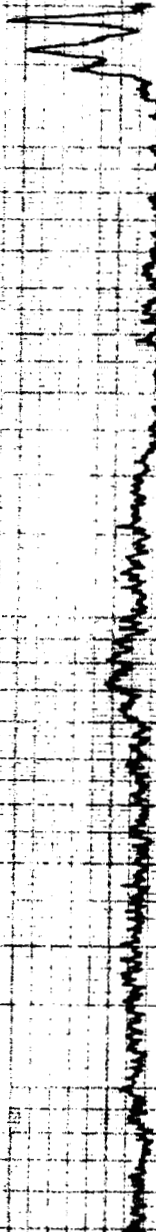
Y AXIS CAL: 18 INCH

X AXIS CAL: 5-2000 Hz

Re-Entry F
Nose Vibration
Nose No1

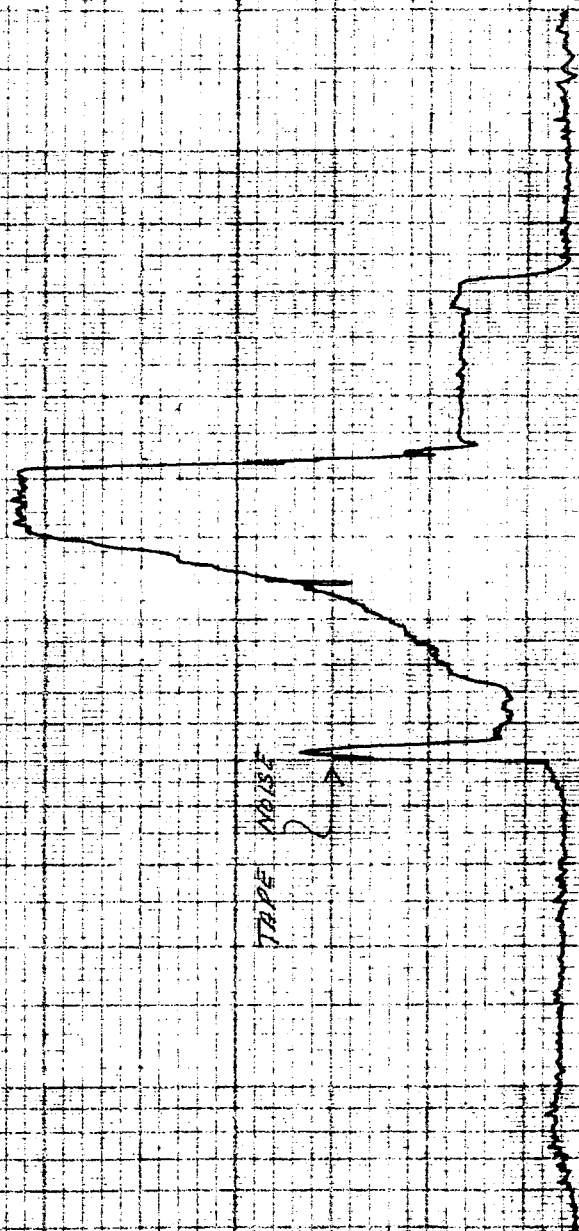
AXIAL SINE FLIGHT
ASSURANCE

9.0 Hz
FREQUENCY



X AXIS CAL: 5-2000 Hz

AXIAL SINE FLIGHT
ASSURANCE



TRP 58181

96-9K

FREQUENCY

ITEM: NO. 34

DWG. SK 56163426 I. NO: 8758

S/N: EDC PROG: VRC

CHANNEL: 4 NOSE AXIAL

DIRECTION: AXIAL MACH:

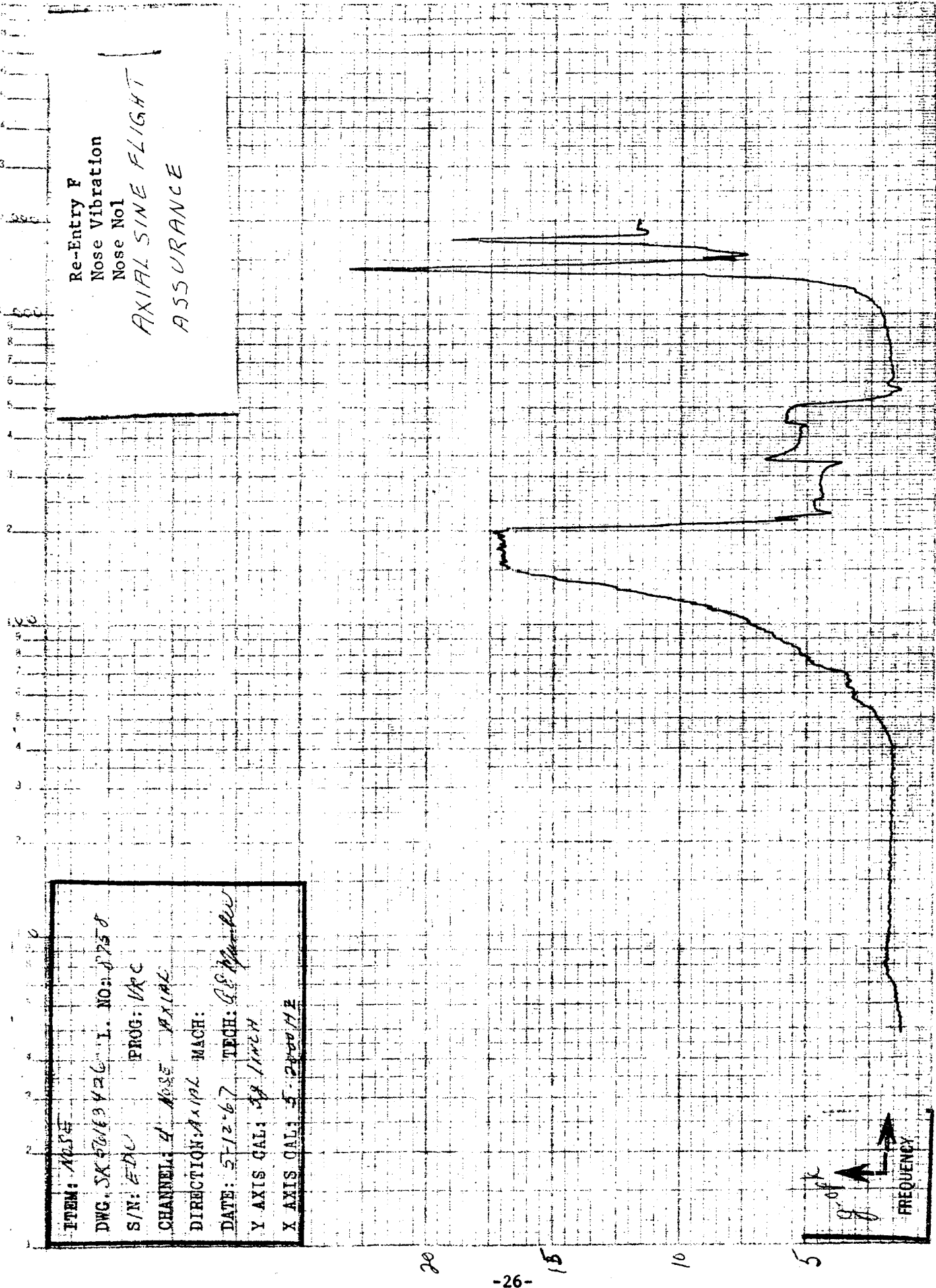
DATE: 5-12-67 TECH: G. S. H. H. H.

Y AXIS GAL: 1/8 INCH

X AXIS GAL: 5.0000 HZ

Re-Entry F
Nose Vibration
Nose No1

AXIAL SINE FLIGHT
ASSURANCE



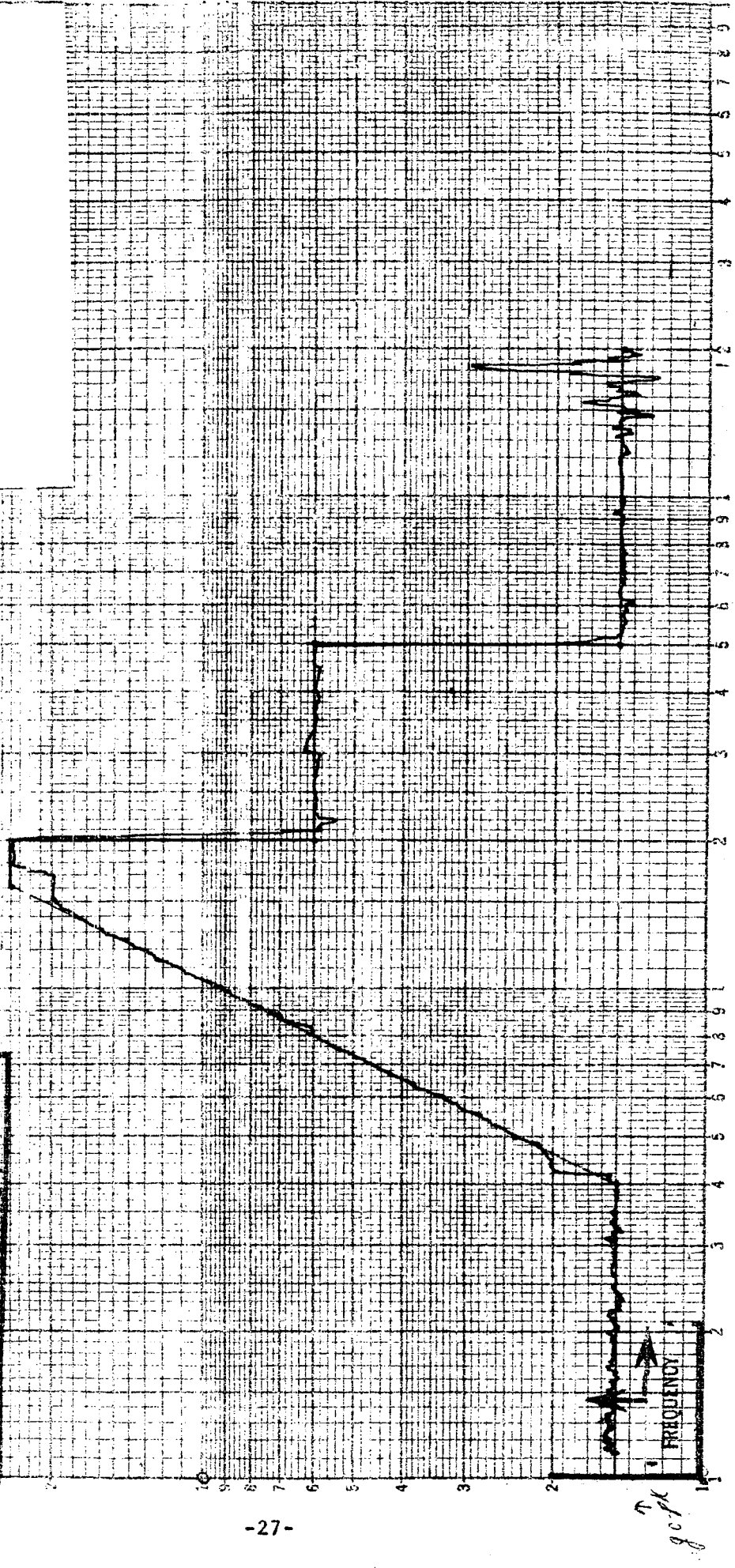
2 1 0 9 8 7 6 5 4 3 2 1

Re-Entry F
Nose Vibration
Nose No. /

AXIAL SINE QUAL.

2 1 0 9 8 7 6 5 4 3 2 1

1052
5K56163-426
871 ERU
CHANNEL CONTROL FIG. 2
DIRECTION AXIAL MAGN 207
DATE 5-9-67
Y AXIS CAL 10, 100, 1000
X AXIS CAL 10, 2000 Hz



ITEM: N05F

DWG. 545543-424 L. NO. 8758

S/N: 500 PROG: VRL

CHANNEL: 990 0744 FIG. 5

DIRECTION: AXIAL MACH: 0.52

DATE: 5-13-67 TECH: R. E. [unclear]

Y AXIS CAL: 1g/1000

X AXIS CAL: 5-2000 Hz

Re-Entry F
Nose Vibrator
Nose No 1

AXIAL SINE QUI

TAPE NOISE

1500 Hz
100 Hz

EL-TRUCK COVER

9.0-10

FREQUENCY

ITEM: NOISE

PROJ: 2132141-421 L. NO. 2252

SINCE: 7/85 PROJ: VKC

CHANNEL: #2 40° YAW RIG 5

DIRECTION: 2132141 MAG: 0.50

DATE: 5-73-62 TECH: G. E. Thompson

Y AXIS CAL: 18/INCH

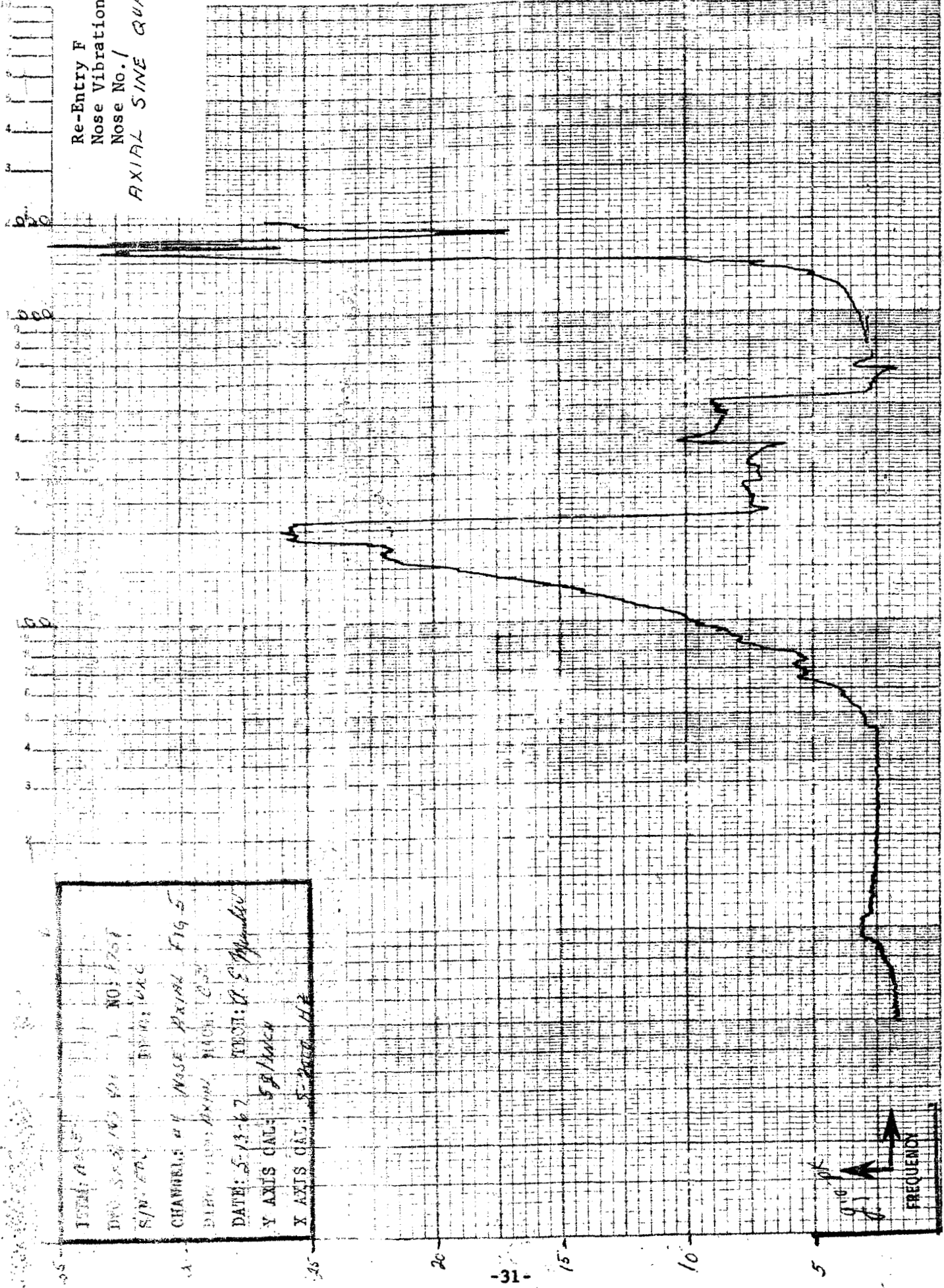
X AXIS CAL: 5-2000 Hz

Re-Entry F
Nose Vibration
Nose No. 1
AXIAL SINE QUAL.

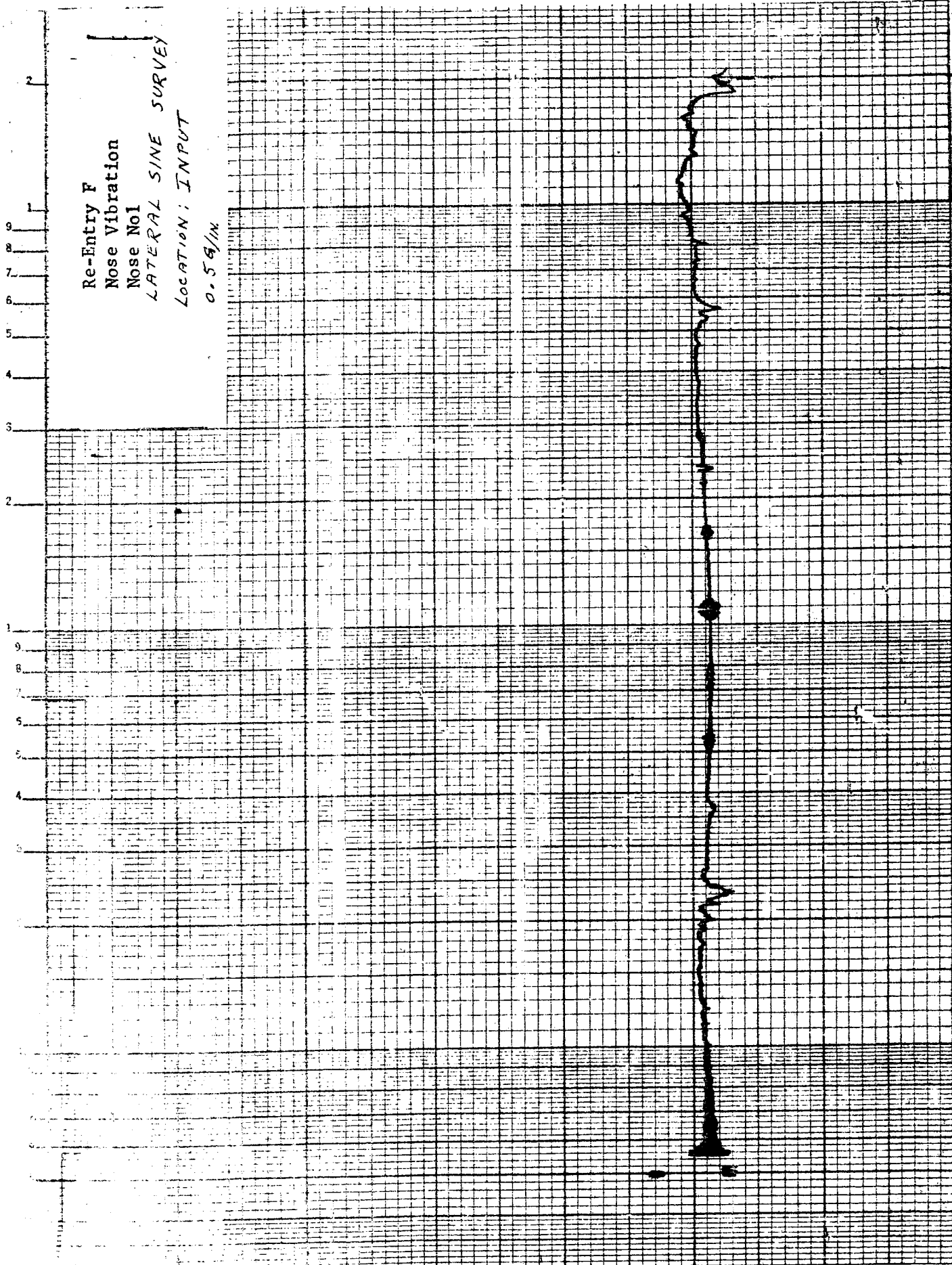
0.01 G
FREQUENCY

TEST: A-5
 DOW: S-3/103 01 NO: 1701
 S/N: 701
 CHANNELS: 4 NOSE AXIAL FIG 5
 DATE: 5-13-67 TEST: A-5
 Y AXIS CAL: 5g/much
 X AXIS CAL: 5 Hz/much

Re-Entry F
 Nose Vibration
 Nose No. 1
 AXIAL SINE QUR



Re-Entry F
 Nose Vibration
 Nose No1
 LATERAL SINE SURVEY
 LOCATION: INPUT
 0.5G/IN

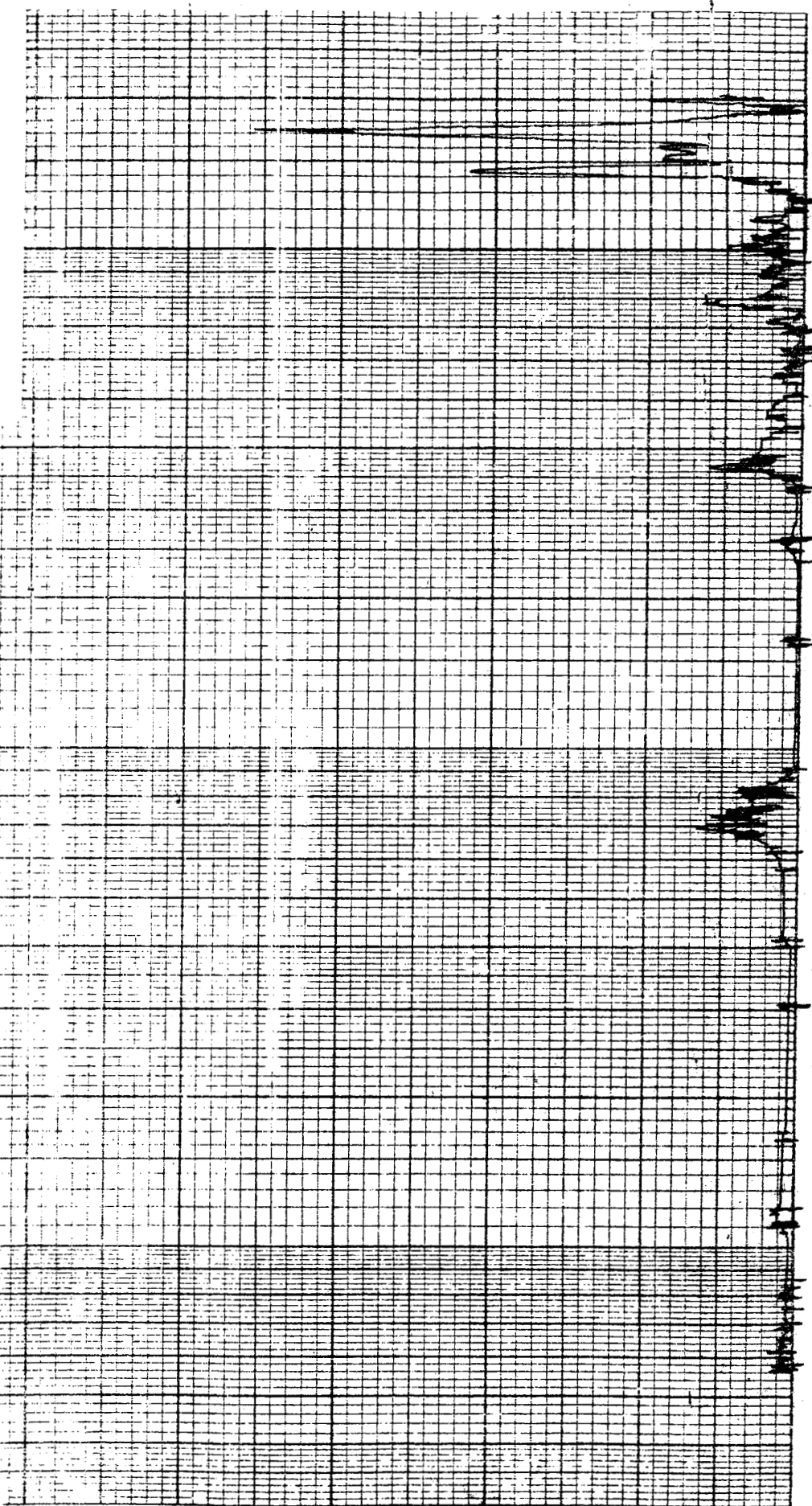


ACCELERATION - G (O-P)

FREQUENCY - (CPS)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
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79
80
81
82
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85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100

Re-Entry F
Nose Vibration
Nose No. 1
Lateral Sine Survey
Location 2
0.2 G_{rms}

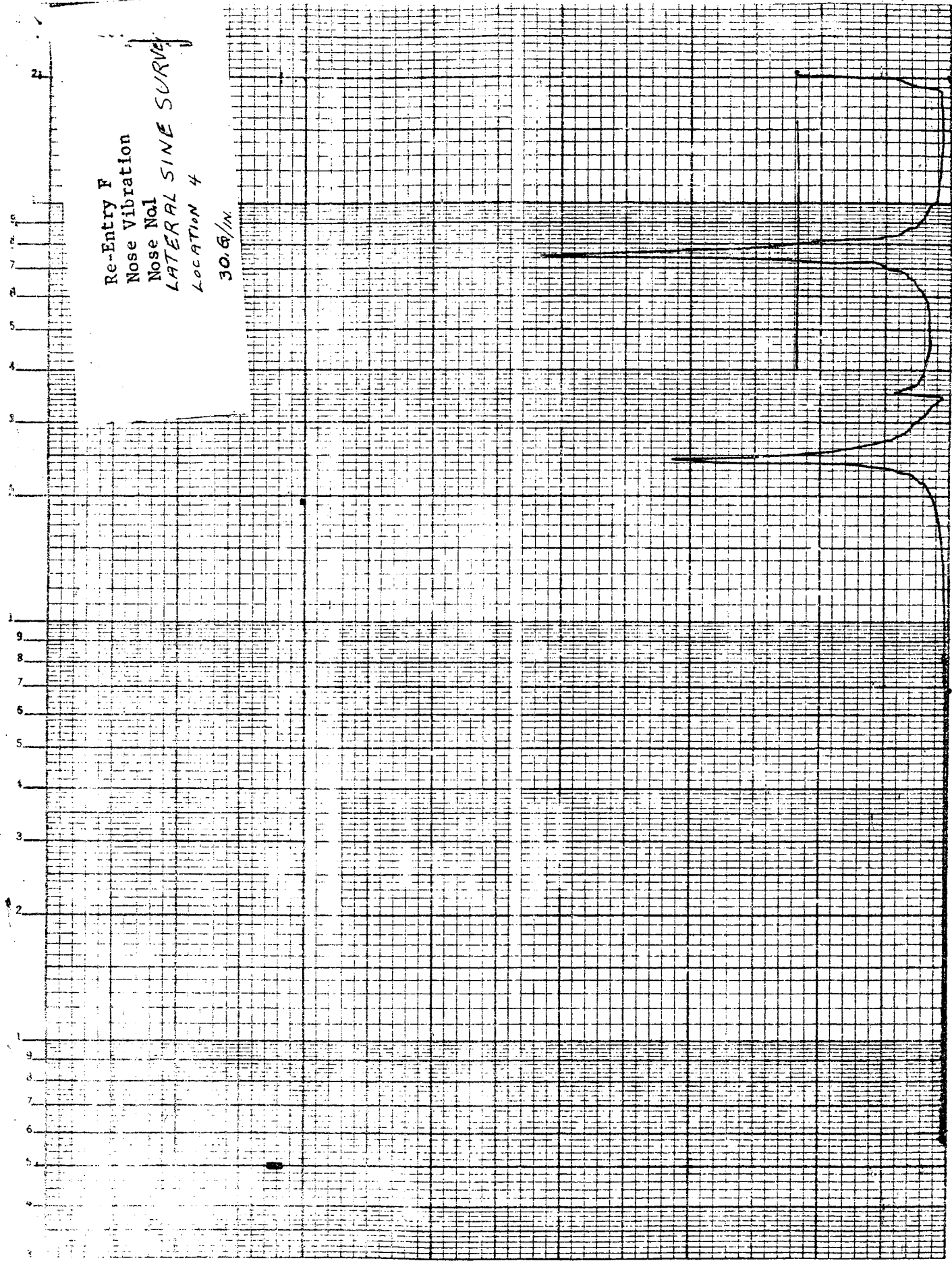


ACCELERATION - Gs (O-P)

Re-Entry F
 Nose Vibration
 Nose No. 1
 Lateral Sine Survey
 Location 3
 0.5 G/m.

FREQUENCY - (CPS)

ACCELERATION - G (O-P)



Re-Entry F
Nose Vibration
Nose No. 1
LATERAL SINE SURVEY
LOCATION 4
30.6/IN.

ACCELERATION - G (0.25)

REENTRY VIBRATION

Re-Entry F

Nose No. /

Nose Vibration

LATERAL Direction

Random Flight Assurance

Lead No. IMPUT

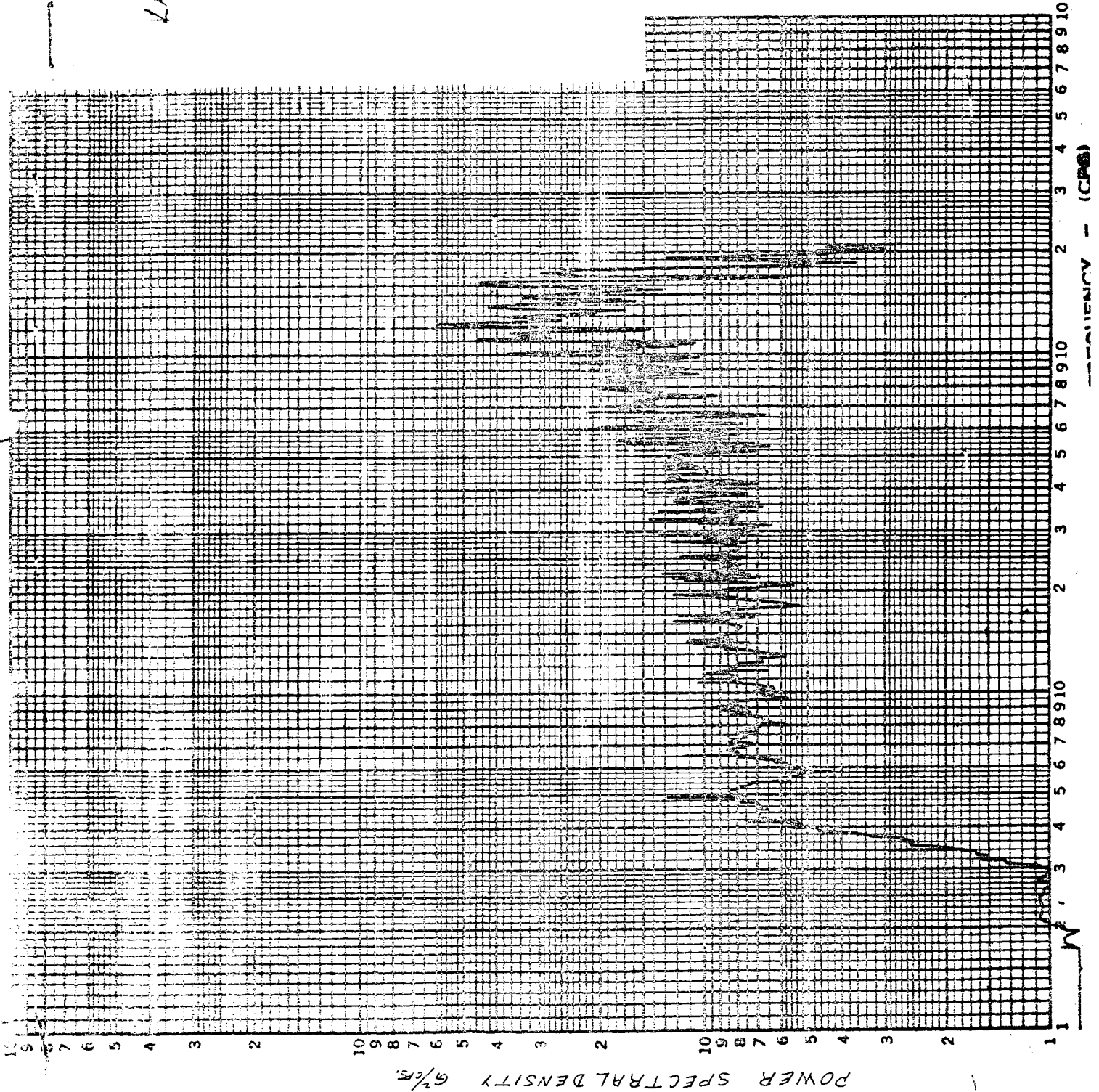
Overall Level = 7.5 G (rms)

10 G/cas F₀ SCALE

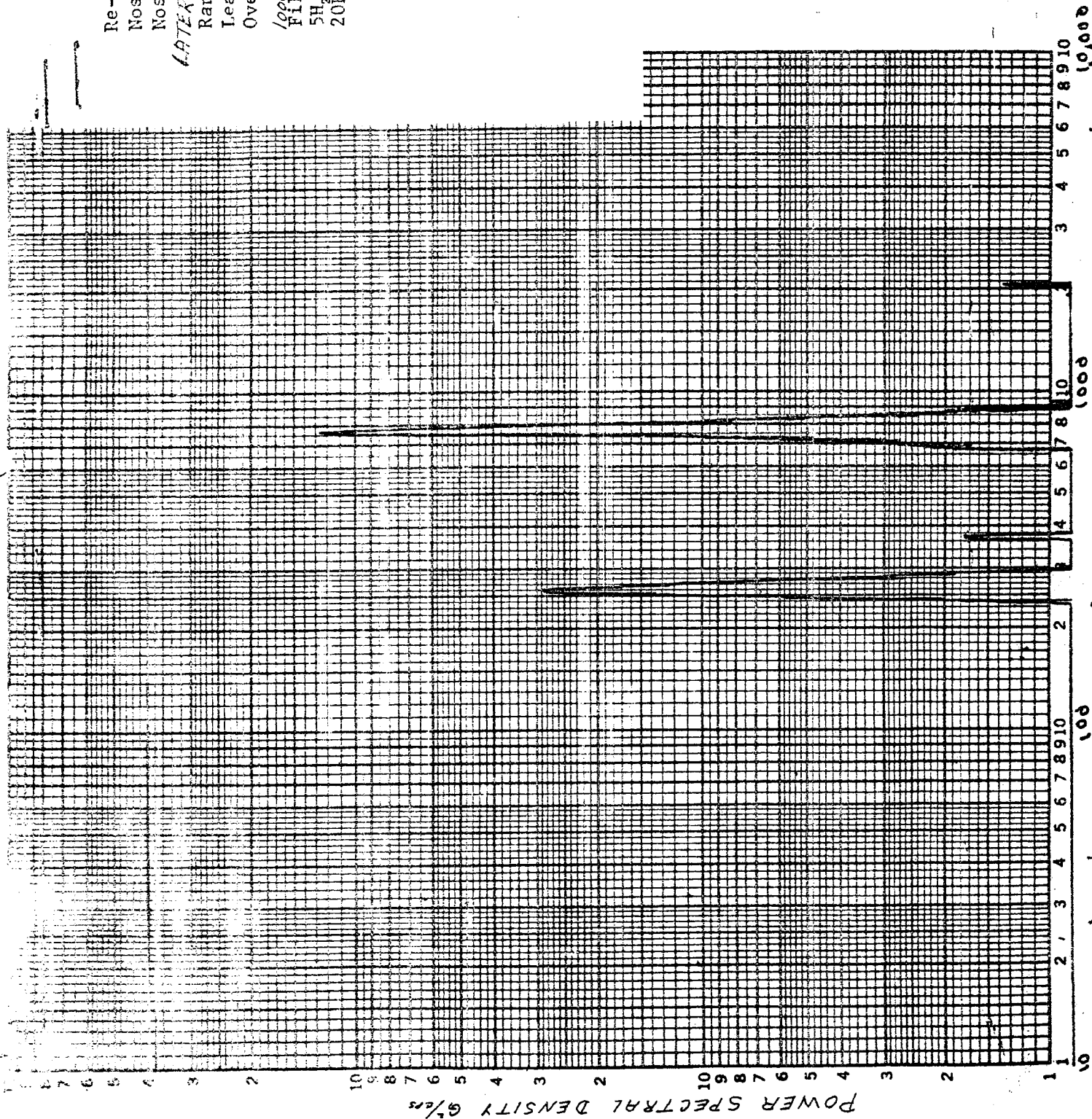
Filter Bandwidth

5Hz to 100Hz

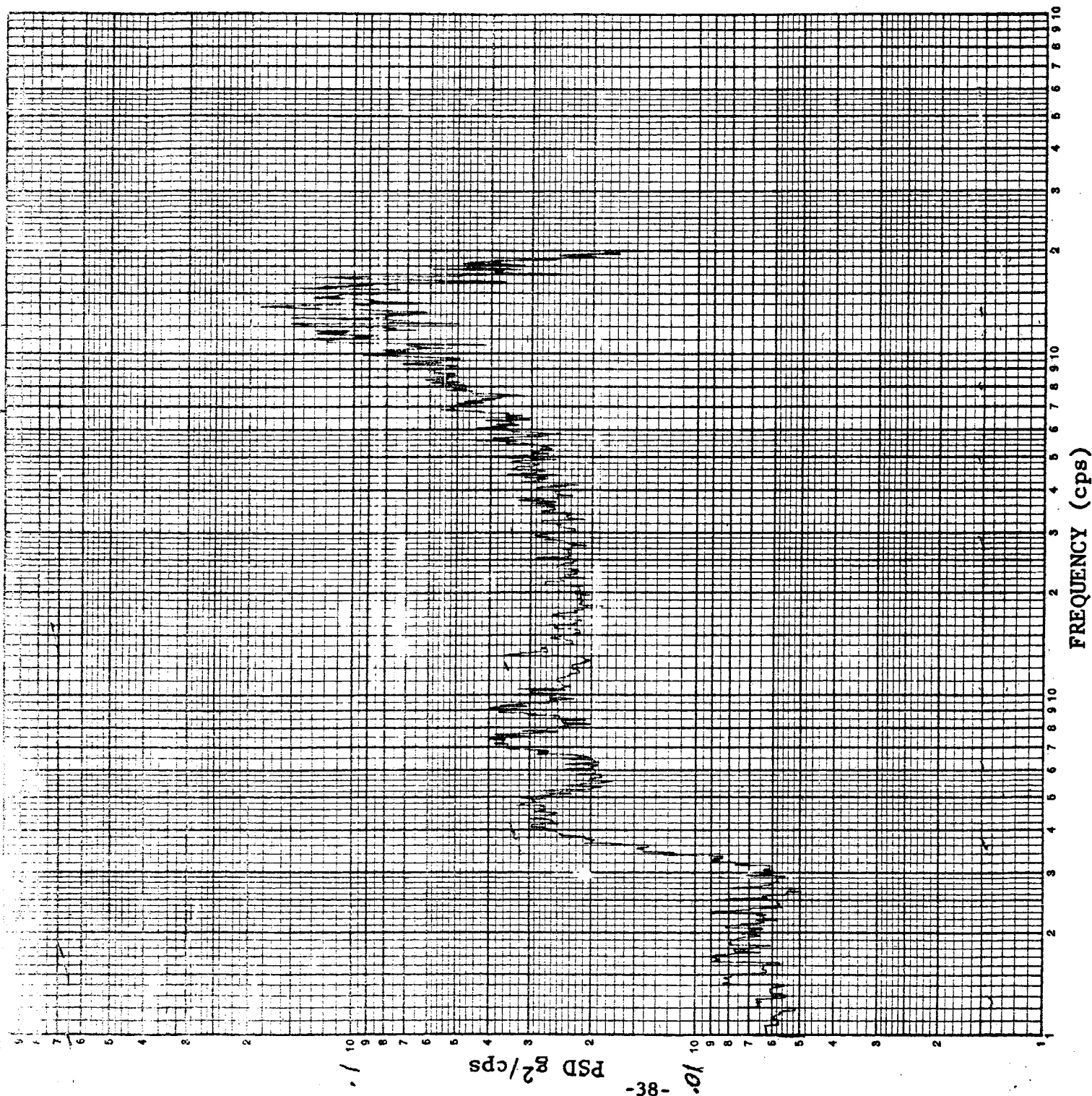
20Hz to 2KHz



Re-Entry F
 Nose No. /
 Nose Vibration
 LATERAL Direction
 Random Flight Assurance
 Lead No. 4
 Overall Level = 74g(rms.)
 1000 G's FULL SCALE
 Filter Bandwidth
 5Hz to 100Hz
 20Hz to 2KHz

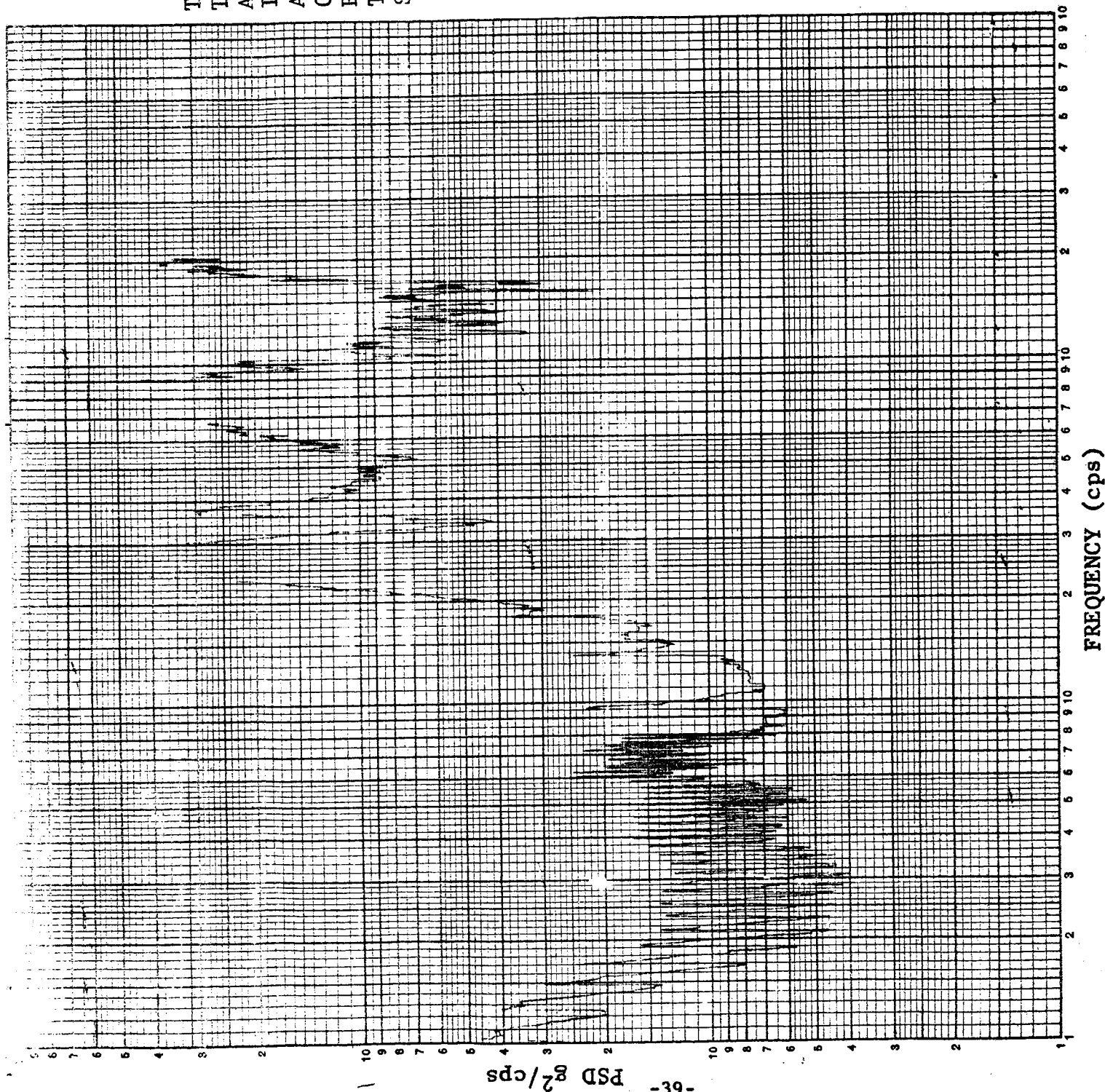


TEST SPECIMEN RE-ENTRY
 TEST TYPE NOISE
 AXIS 6AT DATE 5-5-67
 INPUT LEVEL QUAD
 ACCEL. STATION INPUT
 OVERALL LEVEL 11.24 g(RMS)
 FILTER BANDWIDTH 5+20 cps
 TIME CONSTANT _____ sec
 SWEEP RATE _____ cps/sec
 1.0 G_r/cps FULL SCALE



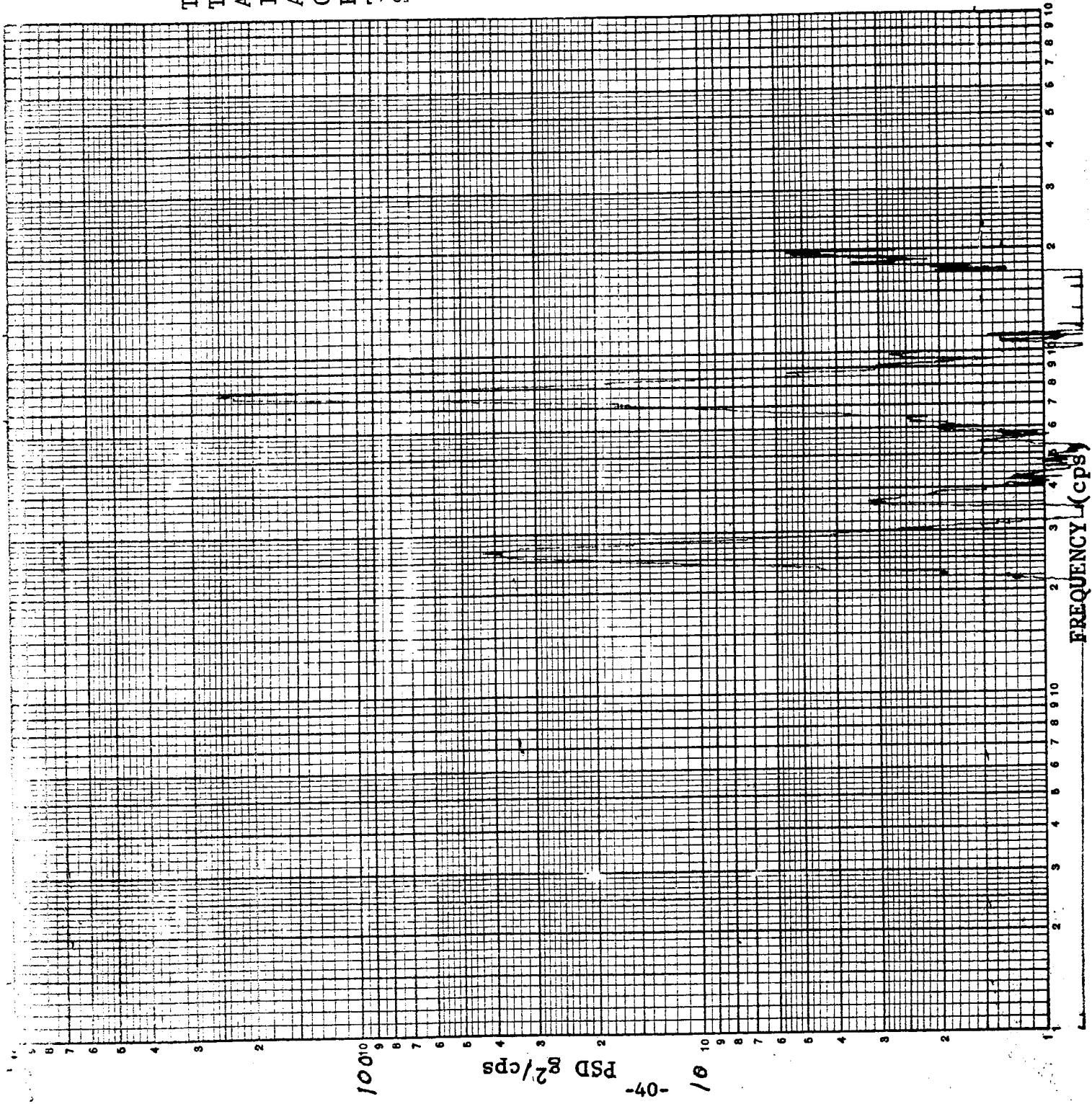
TEST SPECIMEN *RE-ENTRY F*
 TEST TYPE *NOISE #1*
 AXIS *LATERAL* DATE *5-5-6*
 INPUT LEVEL *QUAL.*
 ACCEL. STATION *#4*
 OVERALL LEVEL *127* g (RM)
 FILTER BANDWIDTH *5+20* cps
 TIME CONSTANT _____ sec
 SWEEP RATE _____ cps/sec

10.0 G/cps FULL SCALE



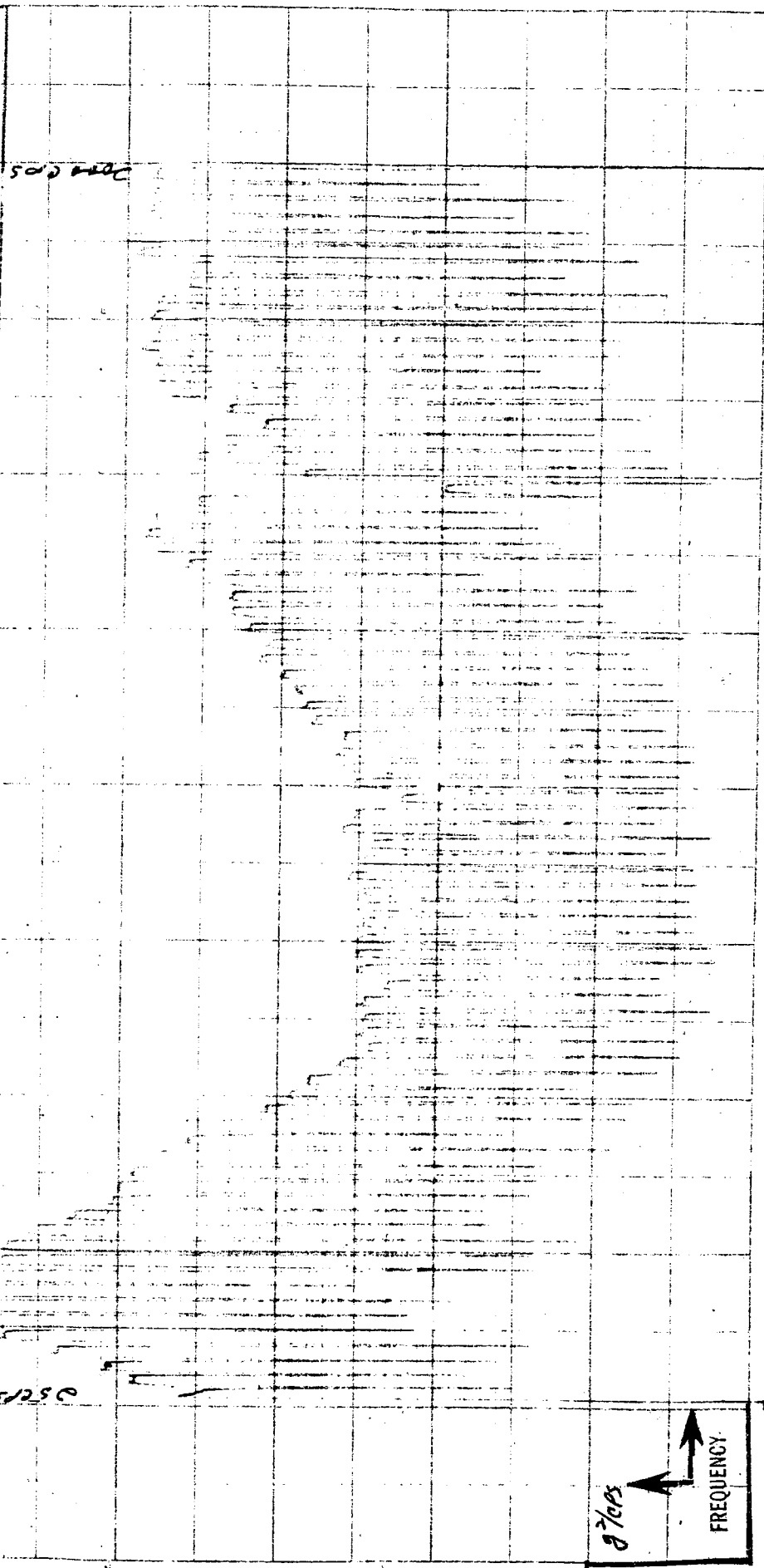
TEST SPECIMEN RE-ENTRY F
 TEST TYPE NOSE #1
 AXIS LONGITUDINAL DATE 5-5-67
 INPUT LEVEL QUAL
 ACCEL. STATION 4
 OVERALL LEVEL 127 g (RMS)
 FILTER BANDWIDTH 5420 cps
 TIME CONSTANT 5 + 1.25 sec.
 SWEEP RATE cps/sec

1000 G/cps FULL SCALE



ANALYZED CURVE 6.4 Grms
 6.92 GRMS
 TIME 2 MIN
 ANALYZER FILTER BW 25 CPS
 SYSTEM TIME CONSTANT 4 SEC
 AMPLITUDE ACCURACY $\pm 7\%$

LR 8758
 ITEM RE-ENTRY "F" NOSE #1
 DWG. NO. 5K56163-A26
 S/N EDU
 DIRECTION AXIAL - ACCIDENTAL - 90° AXIAL
 DATE 5-14-67 TECH J. Bulow
 Y AXIS CAL IS 10 db PER INCH
 FOR TEST SPECIFICATION QUAL.
 SEE LAB REQUEST
 C-50



ANALYZED CURVE 6.4 GYMS
INPUT

52.3 GRMS

TIME 2 MIN

ANALYZER FILTER BW 25 CPS

SYSTEM TIME CONSTANT 4 SEC

AMPLITUDE ACCURACY $\pm 7\%$

LR 0758

ITEM RE-ENTRY "F" NOSE #1

DWG. NO. 5K56163-926

S/N EDU

DIRECTION AXIAL - ACCEL #4 - NOSE #1

DATE 5-14-67 TECH L. Butler

Y AXIS CAL IS 10 db PER INCH

FOR TEST SPECIFICATION QUAL

SEE LAB REQUEST

C-50

50 CPS

5.0

-42-

0.5

10.5

8% CPS

FREQUENCY

ANALYZED CURVE
3.53 GRMS

TIME 2 MIN
ANALYZER FILTER BW 25 CPS
SYSTEM TIME CONSTANT 4 SEC
AMPLITUDE ACCURACY $\pm 7\%$

LR 8758

ITEM RE-ENTRY 'F' NOSE #1

DEG. NO. SK56163-426

S/N EDU

DIRECTION AXIAL - Accel #2 - 90° YAW

DATE 5-14-67 TECH *A. Butler*

Y AXIS GAL IS 10 db PER INCH

FOR TEST SPECIFICATION QUAL

SEE LAB REQUEST

C-50

0.005

0.005

-43-

g/cps

FREQUENCY

ANALYZED CURVE 6.46_{GRMS}
3.67 GRMS INPUT

TIME 2 MIN

ANALYZER FILTER BW 25 CPS
SYSTEM TIME CONSTANT 4 SEC
AMPLITUDE ACCURACY $\pm 7\%$

LR 8758

ITEM RE-ENTRY "F" NOSE #1

DWG. NO. SK 56163-426

S/N EDU

DIRECTION AXIAL-ACCEL #3 - 90° PITCH

DATE 5-14-67 TECH J. Butler

Y AXIS CAL IS 10 db PER INCH

FOR TEST SPECIFICATION QUAL

SEE LAB REQUEST

C-50

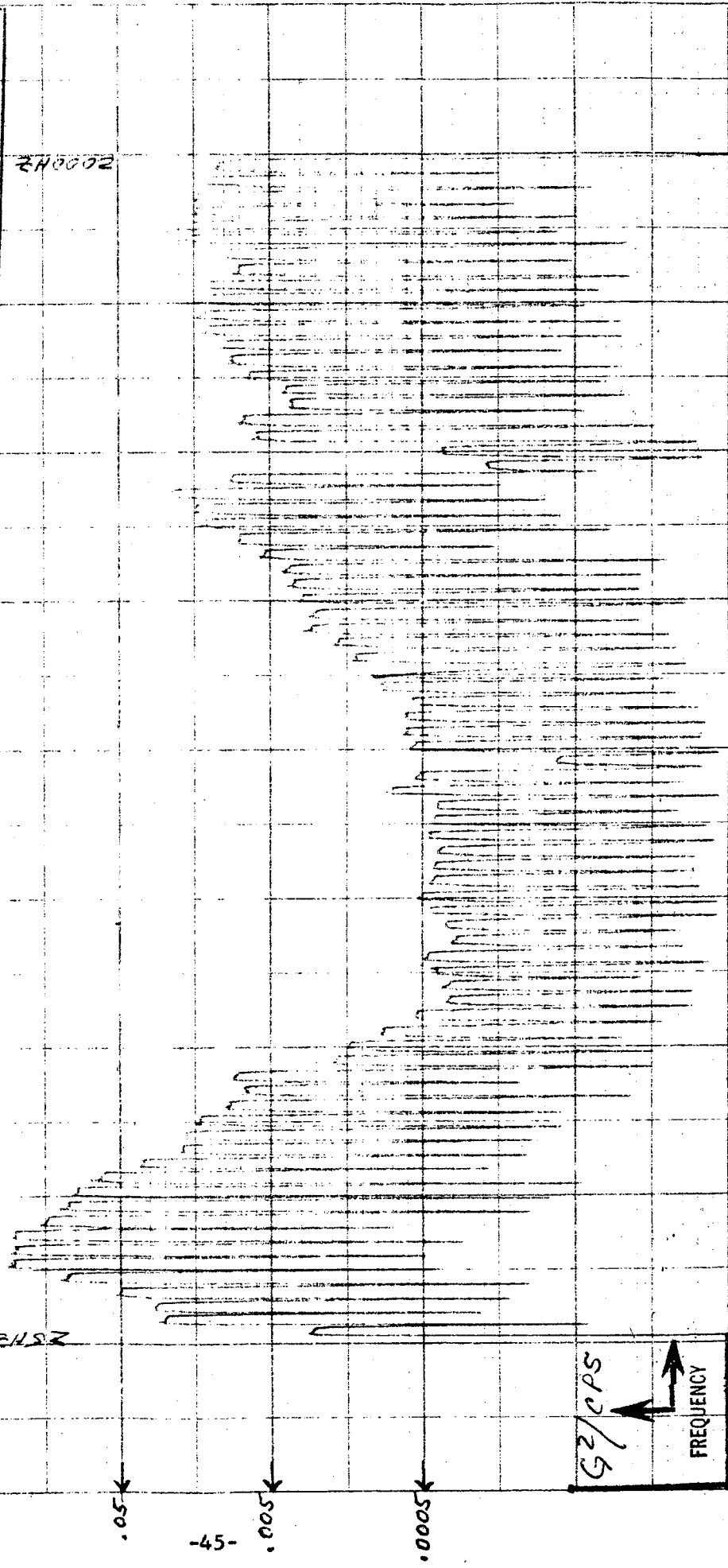
2400 cps

1000 cps

FREQUENCY

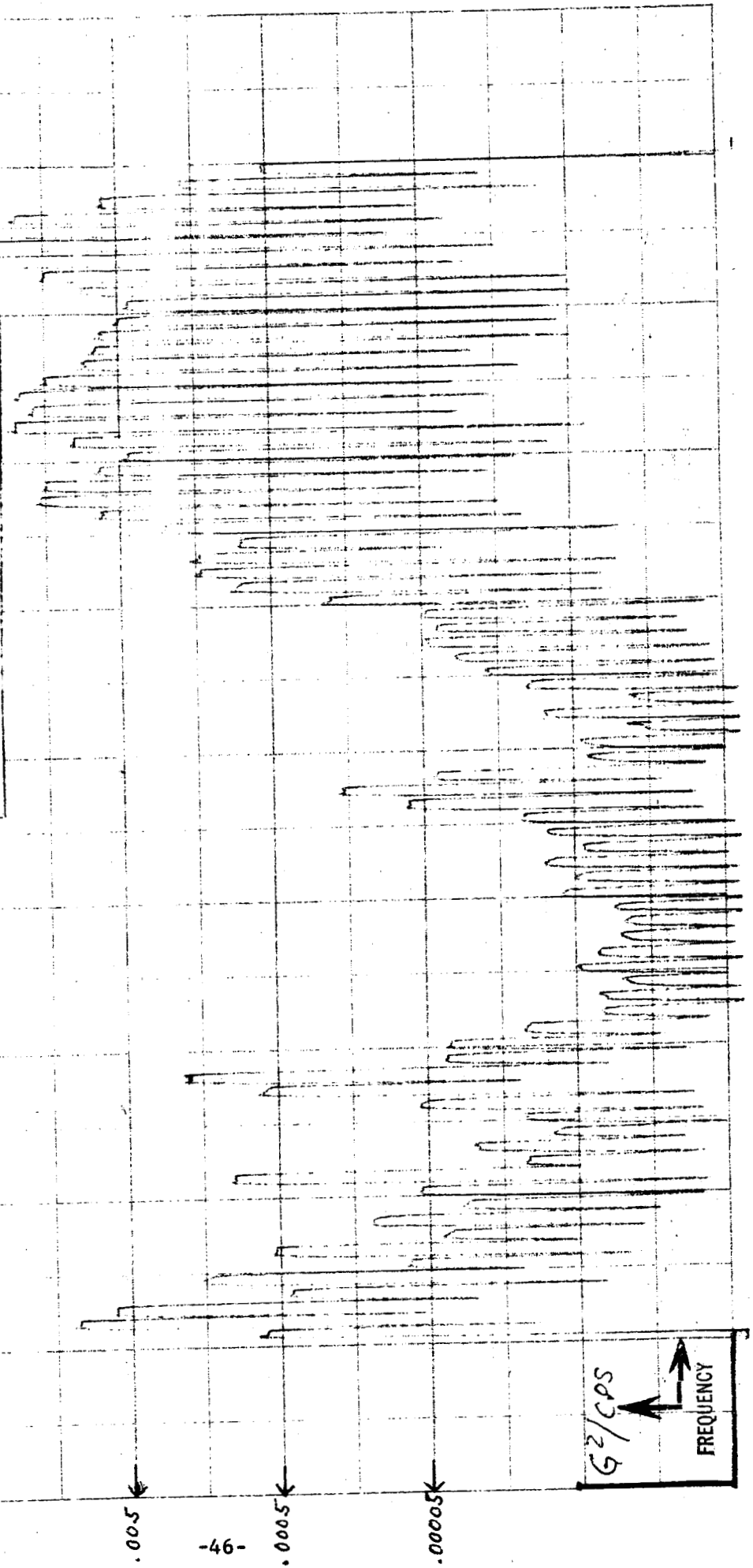
ANALYZED CURVE 46 GRMS
 5.09 GRMS INPUT
 FIG 6
 TIME 1 MIN
 ANALYZER FILTER BW 25 CPS
 SYSTEM TIME CONSTANT 4 SEC
 AMPLITUDE ACCURACY $\pm 7\%$

LR 8758
 ITEM ACENIN V "F" NOSE #1
 DWG. NO. SK 56163-426
 S/N SDO
 DIRECTION AXIAL ACCEL M 90° HORIZ
 DATE 5-9-67 TECH S. H. Slag
 Y AXIS CAL IS 10 GB PER INCH
 FOR TEST SPECIFICATION FLIGHT ASSUR,
 SEE LAB REQUEST
 207



ANALYZED CURVE 4.2 GRMS
2.61 GRMS INPUT
5156
TIME 1 MIN
ANALYZER FILTER B1 25 CPS
SYSTEM TIME CONSTANT 4 SEC
AMPLITUDE ACCURACY $\pm 7\%$

LR 8758
ITEM RE-ENTRY "F" NOSE #1
DWG. NO. SK 56163-426
S/N EDD
DIRECTION AXIAL ACCEL 2-90° VAO
DATE 5-9-67 TECH E.H. Shlgm
Y AXIS CAL IS 10 db PER INCH
FOR TEST SPECIFICATION FLIGHT ASSUR.
SEE LAB REQUEST 207



ANALYZED CURVE 4.6 GRMS
2.68 GRMS 10.407
F146
TIME 1 MIN
ANALYZER FILTER BW 25 CPS
SYSTEM TIME CONSTANT 4 SEC
AMPLITUDE ACCURACY $\pm 7\%$

LR 8758
ITEM RE ENTRY " NOSE #1
DFG. NO. SK 56163-926
S/N EDU
DIRECTION AXIAL ACCEL #3 - 90° RICH.
DATE 5-9-67 TECH Sh. Jalgm
Y AXIS CAL IS 10 db PER INCH
FOR TEST SPECIFICATION FLIGHT ASSUR.
SEE LAB REQUEST 207

.05
-47-
-00005

2000HZ

25HZ

62/cps
FREQUENCY

ANALYZED CURVE 4.6 Grms
38.1 GRMS INPUT

TIME 1 MIN.

ANALYZER FILTER BW 25 CPS
SYSTEM TIME CONSTANT 4 SEC
AMPLITUDE ACCURACY $\pm 7\%$

LR 8758

ITEM RE-ENTRY "F" NOSE #1

DWG. NO. SK56163-426

S/N EDU

DIRECTION AXIAL-ACCEL #4-NOSE AXIAL

DATE 5-8-67 TECH J. Butler

Y AXIS CAL IS 10 db PER INCH

FOR TEST SPECIFICATION FLIGHT ASSUR.

SEE LAB REQUEST

C-50

5000 CPS

5.0

-48-

15

105

g²/cps

FREQUENCY

ITEM: W63E

DSG: S-26/68 426 L. NO: 8758-1

S/N: NA PROD:

CHANNEL: CONTROL (SURVEY)

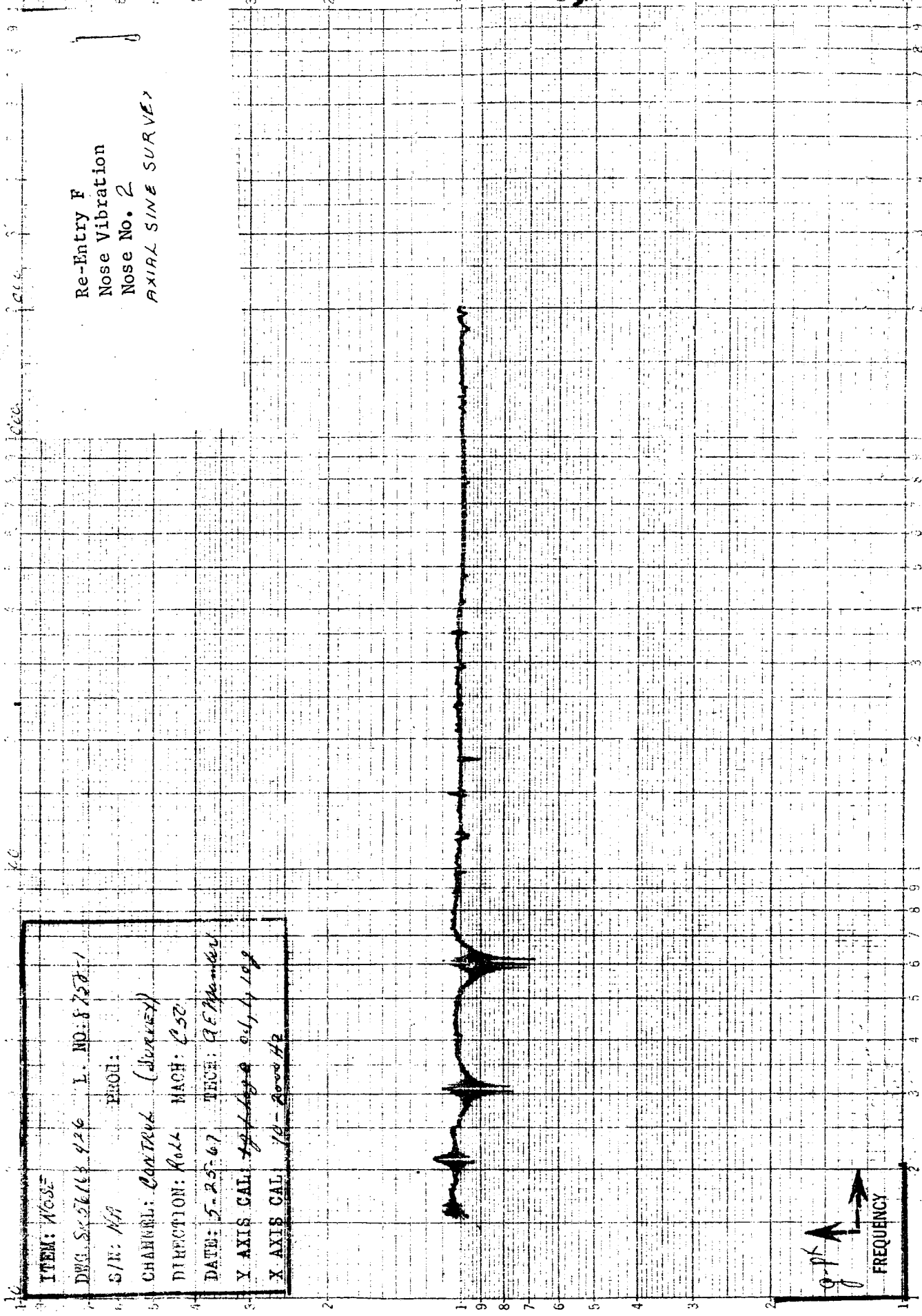
DIRECTION: ROLL MACH: 0.50

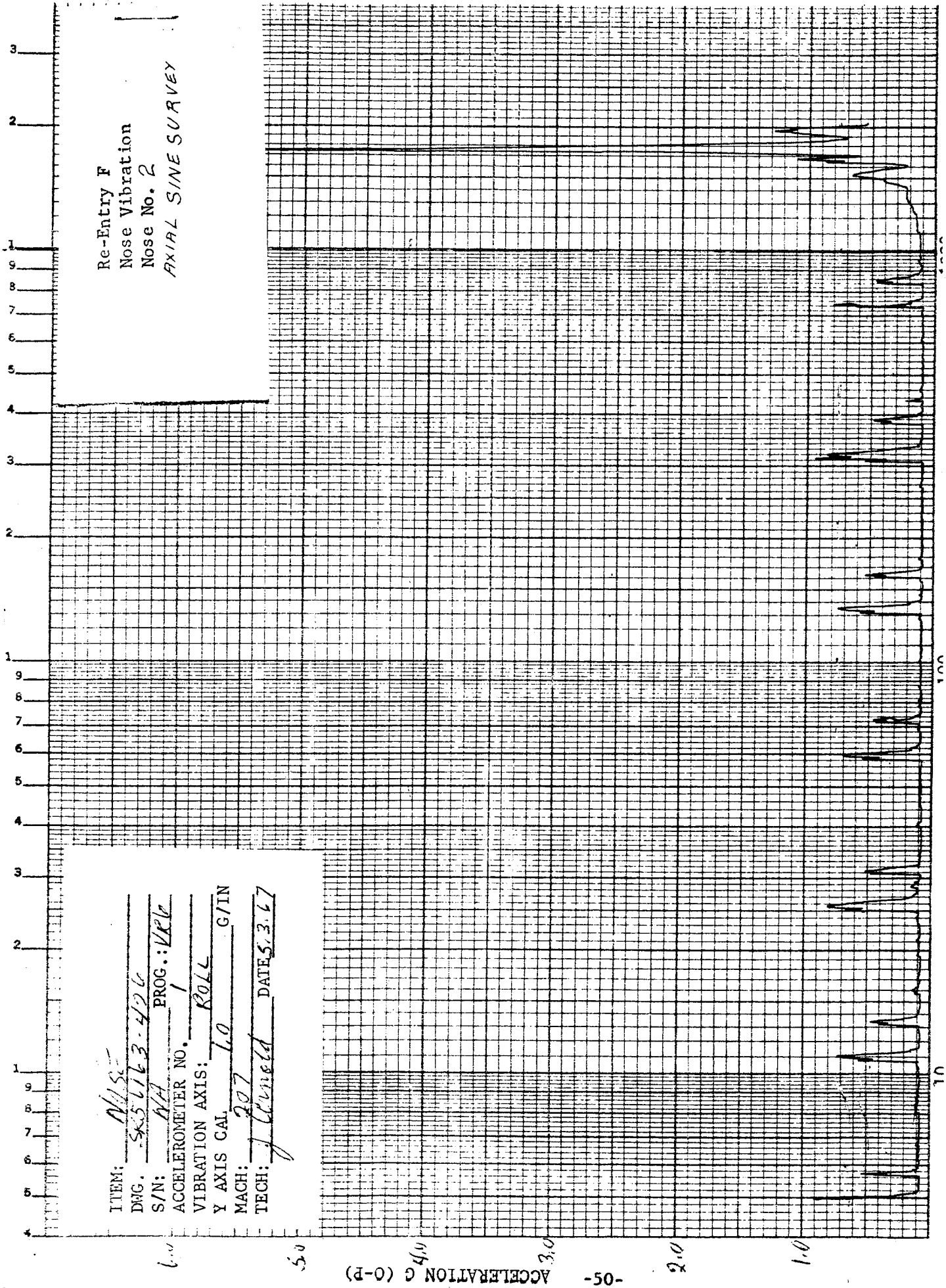
DATE: 5-25-67 TECH: GEMMUR

Y AXIS CAL: 42/1000 0.1/100

X AXIS CAL: 10-2000 Hz

Re-Entry F
Nose Vibration
Nose No. 2
AXIAL SINE SURVEY





Q. C. & T. VIBRATION LABORATORY

3
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4

Re-Entry F
Nose Vibration
Nose No. 2
AXIAL SINE SURVEY

1
9
8
7
6
5
4

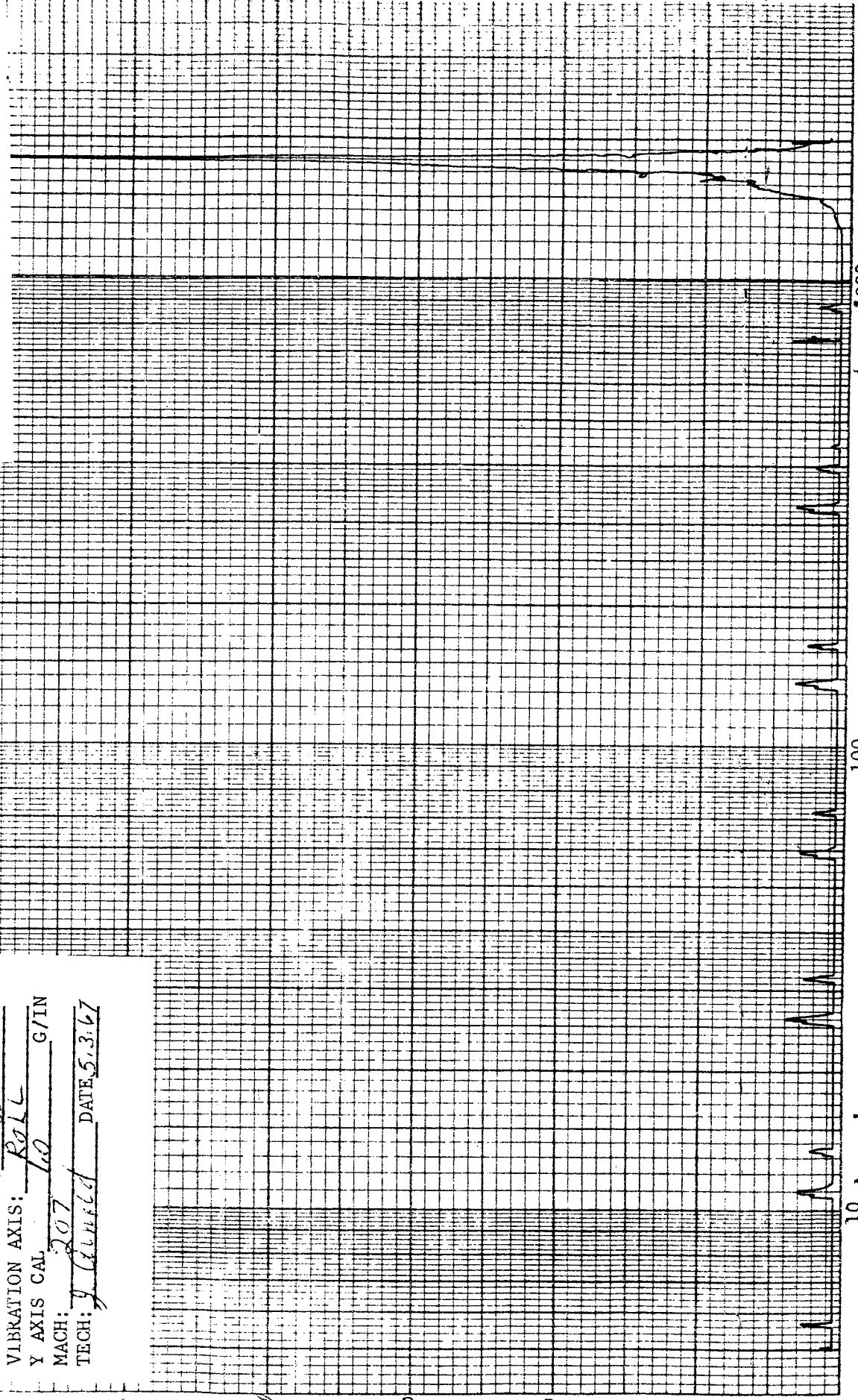
1
9
8
7
6
5
4

ITEM: Nose
DWG. SK56163-426
S/N: NA PROG.: VR6
ACCELEROMETER NO. 2
VIBRATION AXIS: Roll
Y AXIS CAL. 1.0 G/IN
MACH: 207
TECH: J. G. H. H. H. DATE: 5.3.67

-15- ACCELERATION G (O-P)

7.0
6.0
5.0
4.0
3.0
2.0
1.0

10
100
1000



Re-Entry F
Nose Vibration
Nose No. 2
AXIAL SINE SW

ITEM: AD-55
DWG. SK-5616.3-426
S/N: NA PROC.: VR6
ACCELEROMETER NO. 3
VIBRATION AXIS: ROLL
Y AXIS CAL. 66 AMPX. G/IN
MACH: 207
TECH: J. Curwood DATE 3-31-67

3
2
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5
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3
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6
5
4

Re-Entry F
Nose Vibration
Nose No. 2
AXIAL SINE SURVEY

ITEM: Nose
DWG: SK56163-426
S/N: NA PROG.: VR6
ACCELEROMETER NO.: 4-Nose
VIBRATION AXIS: Roll
Y AXIS CAL: 6.06 G/IN
MACH: 207
TECH: J. Linnell DATE: 5.31.67

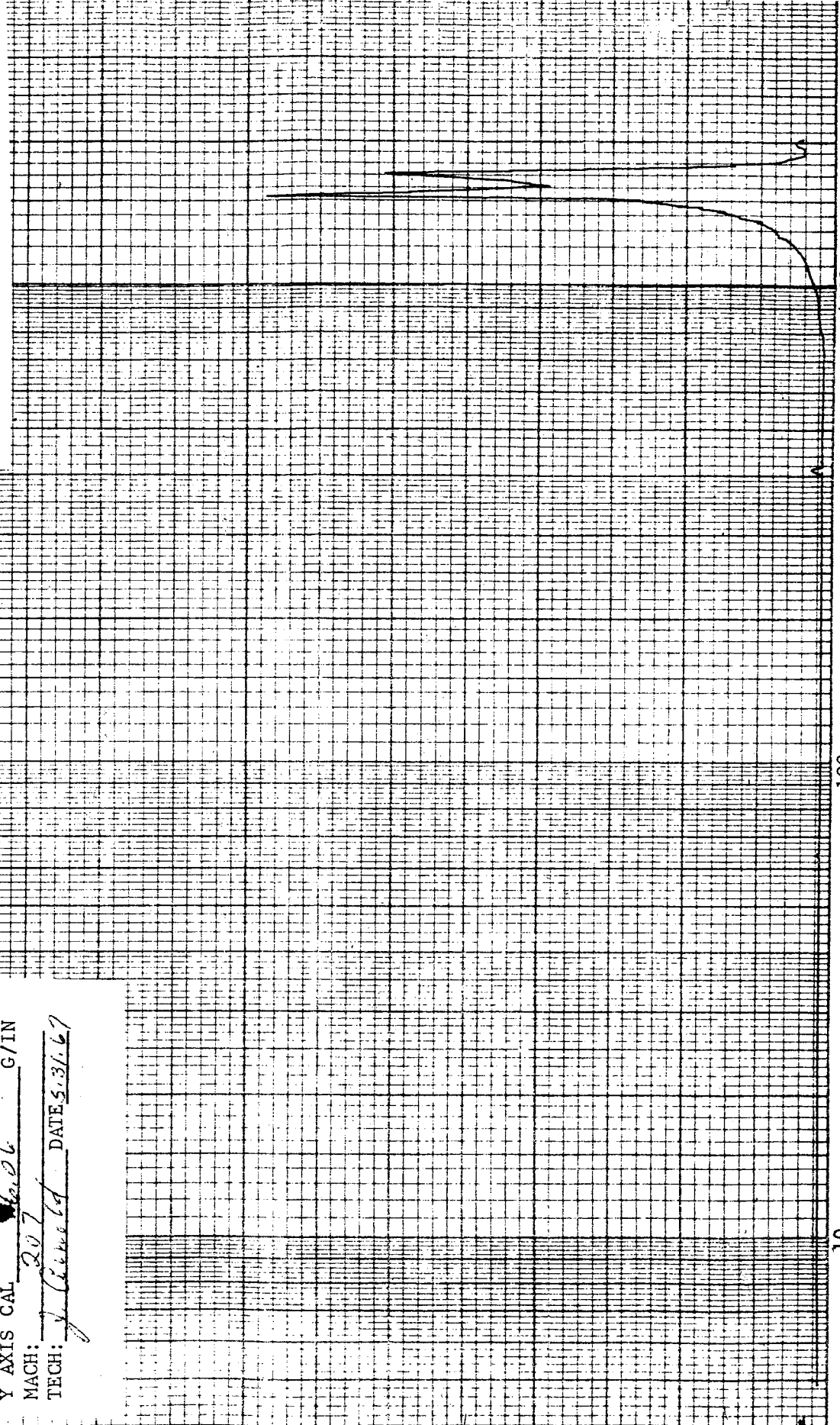
ACCELERATION G (0-P)

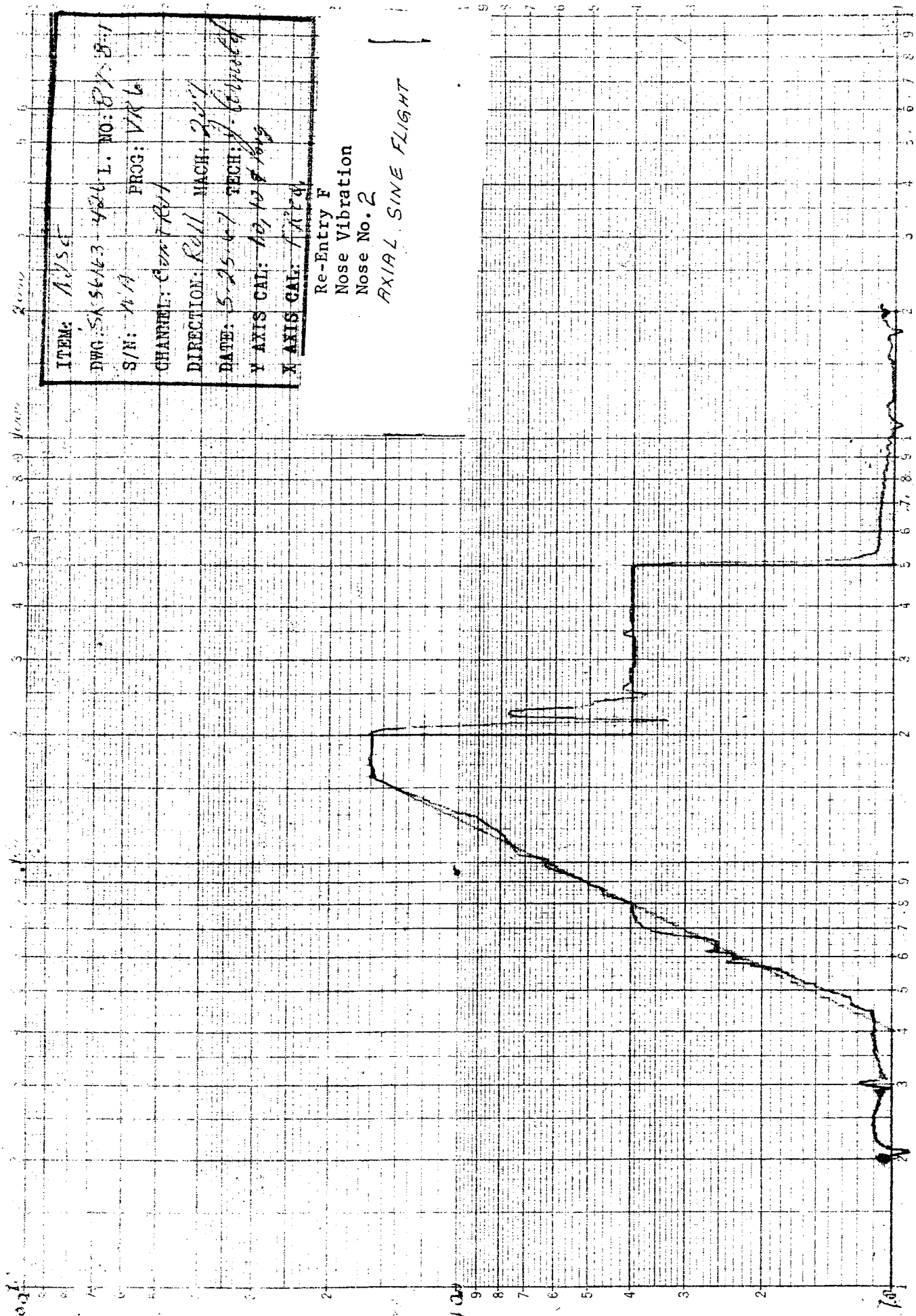
12.12

6.06

10
100

1000





ITEM: 1125C
 DWG: SK56163-426 L. NO: 87-8-1
 S/N: 411 PROG: VRL6
 CHANNEL: CANT-1001
 DIRECTION: Roll MACH: 2.01
 DATE: 5-25-67 TECH: J. Campbell
 Y AXIS CAL: 10, 12.8 Hz
 X AXIS CAL: 11.7 Hz

Re-Entry F
 Nose Vibration
 Nose No. 2

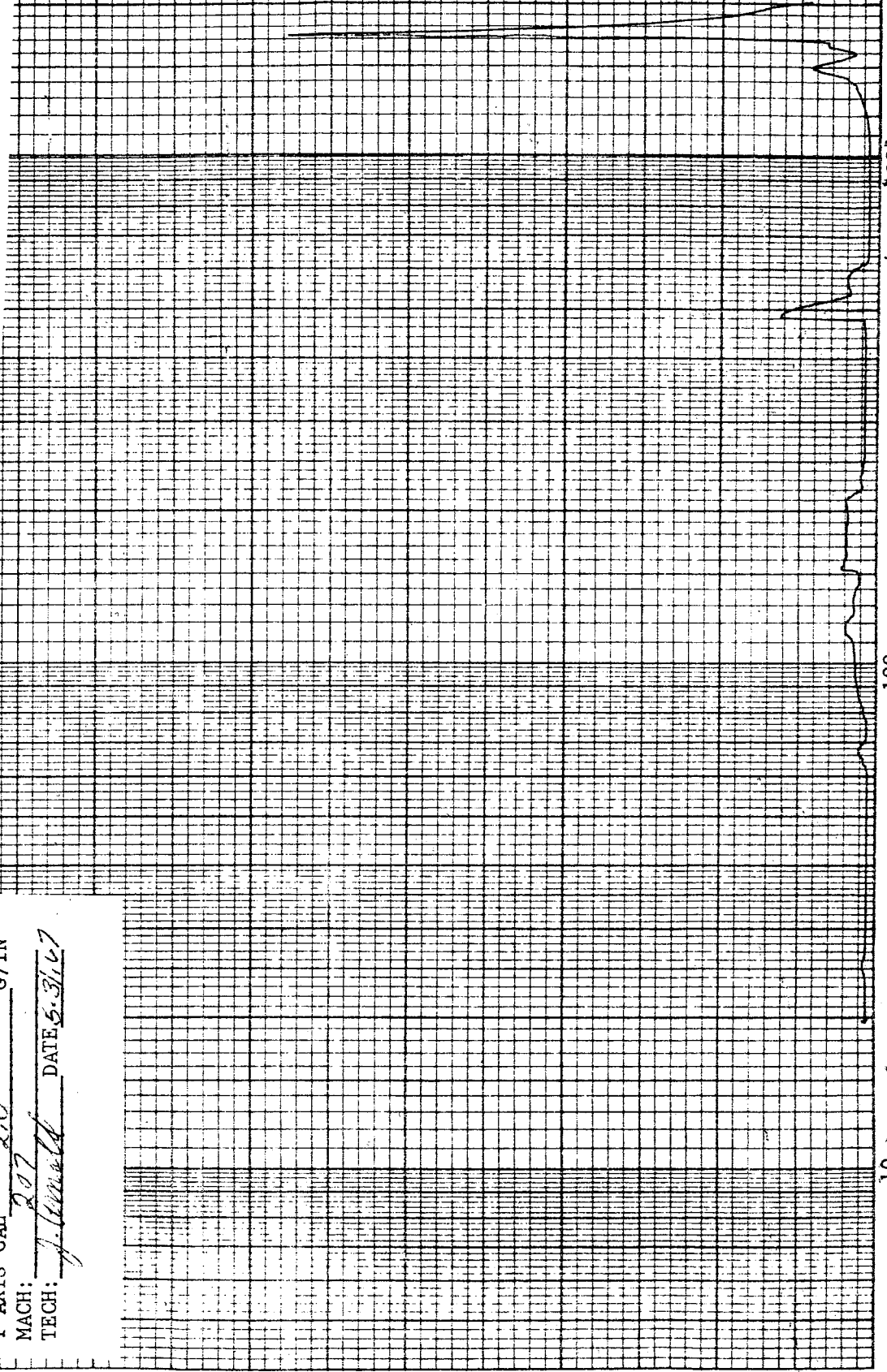
AXIAL SINE FLIGHT



Re-Entry F
Nose Vibration
Nose No. 2
AXIAL SINE FLIGHT

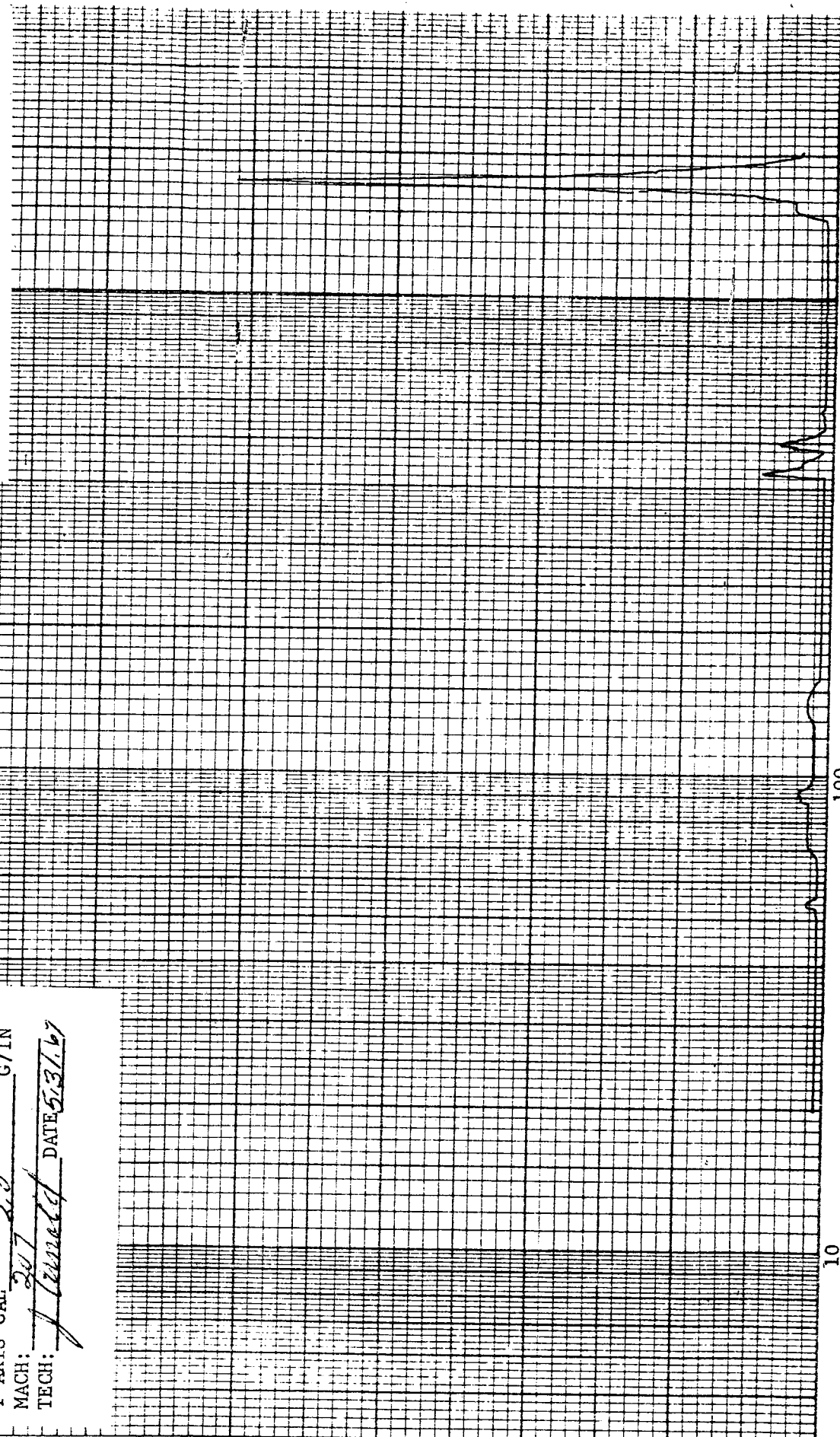
ITEM: N050
DWG: SK56163-426
S/N: NA PROG.: VR6
ACCELEROMETER NO. 1
VIBRATION AXIS: ROLL
Y AXIS CAL: 2.0 G/IN
MACH: 2.07
TECH: J. Arnold DATE 5.31.67

ACCELERATION G (O-P) 2.0 4.0 6.0 8.0 10.0



AXIAL SINE FLIGHT

ITEM: N/A SC-
DWG. SK 56113-426
S/N: NA PROG.: VR6
ACCELEROMETER NO. 2
VIBRATION AXIS: ROLL
Y AXIS CAL 2.0 G/IN
MACH: 207
TECH: J. Arnold DATE 5/3/67



ACCELERATION G (O-P)

Q. C. & T. VIBRATION LABORATORY

3 _____

2 _____

1 _____

9 _____

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7 _____

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5 _____

Re-Entry F
Nose Vibration
Nose No. 2
AXIAL SINE FL

ITEM: NA 507
DWG. SK56163-42C
S/N: RA PROG.: VR6
ACCELEROMETER NO. 53
VIBRATION AXIS: ROLL
Y AXIS CAL. 3.03 G/IN
MACH: 207
TECH: J. Unmold DATE 5/31/67

18.!

1515

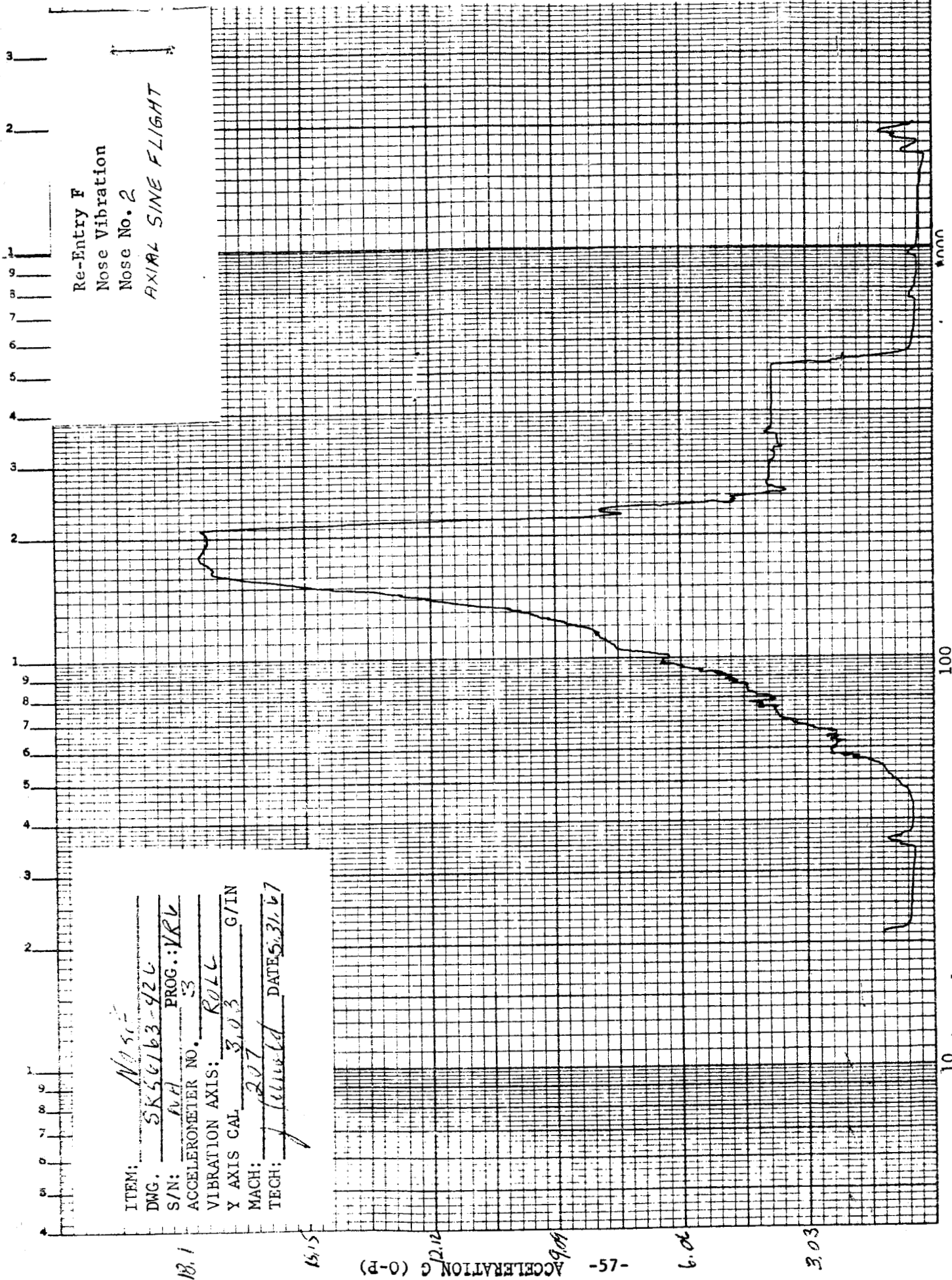
ACCELERATION G (O-P) -57-

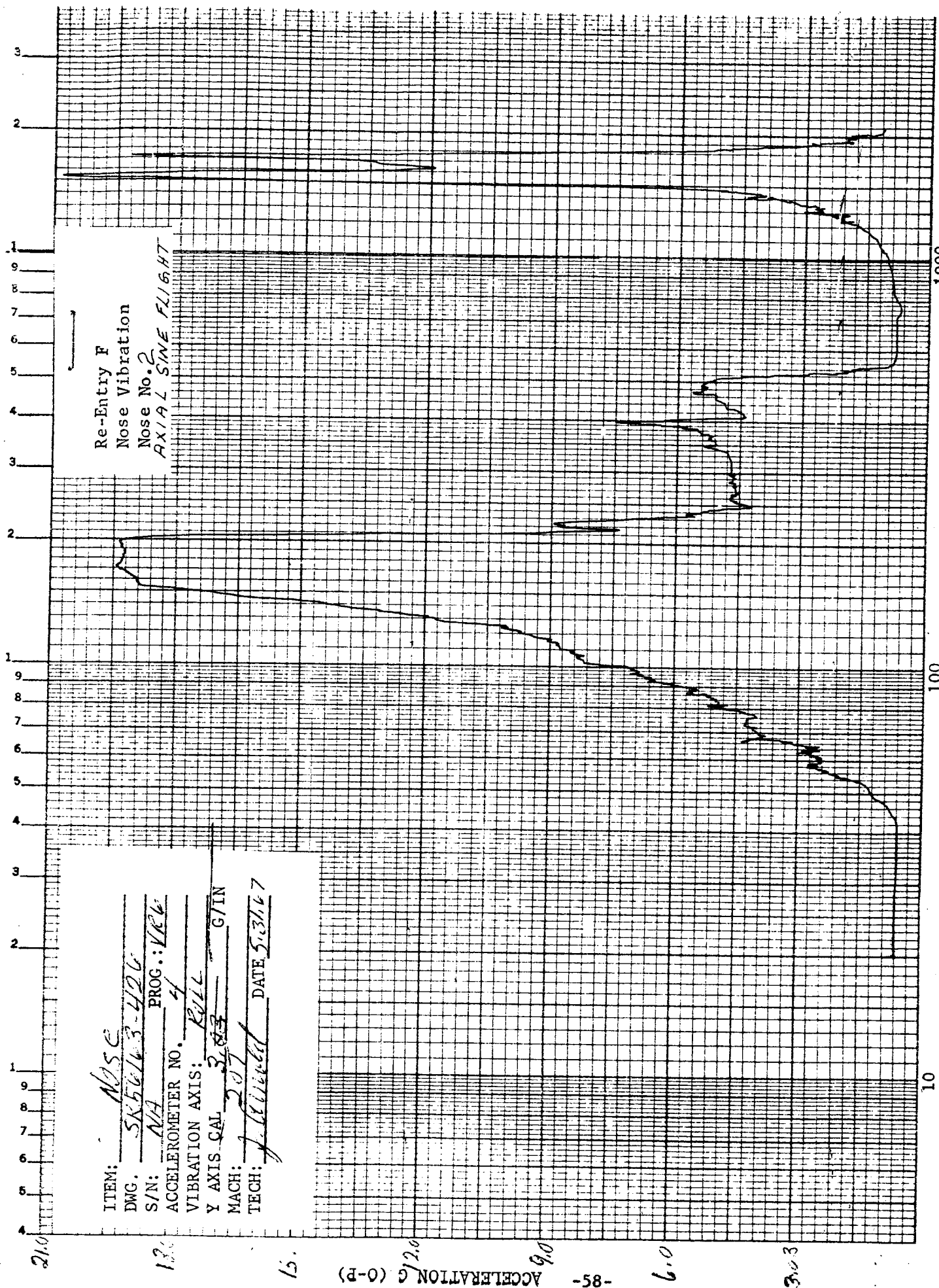
10/11 -57- b. d.

303

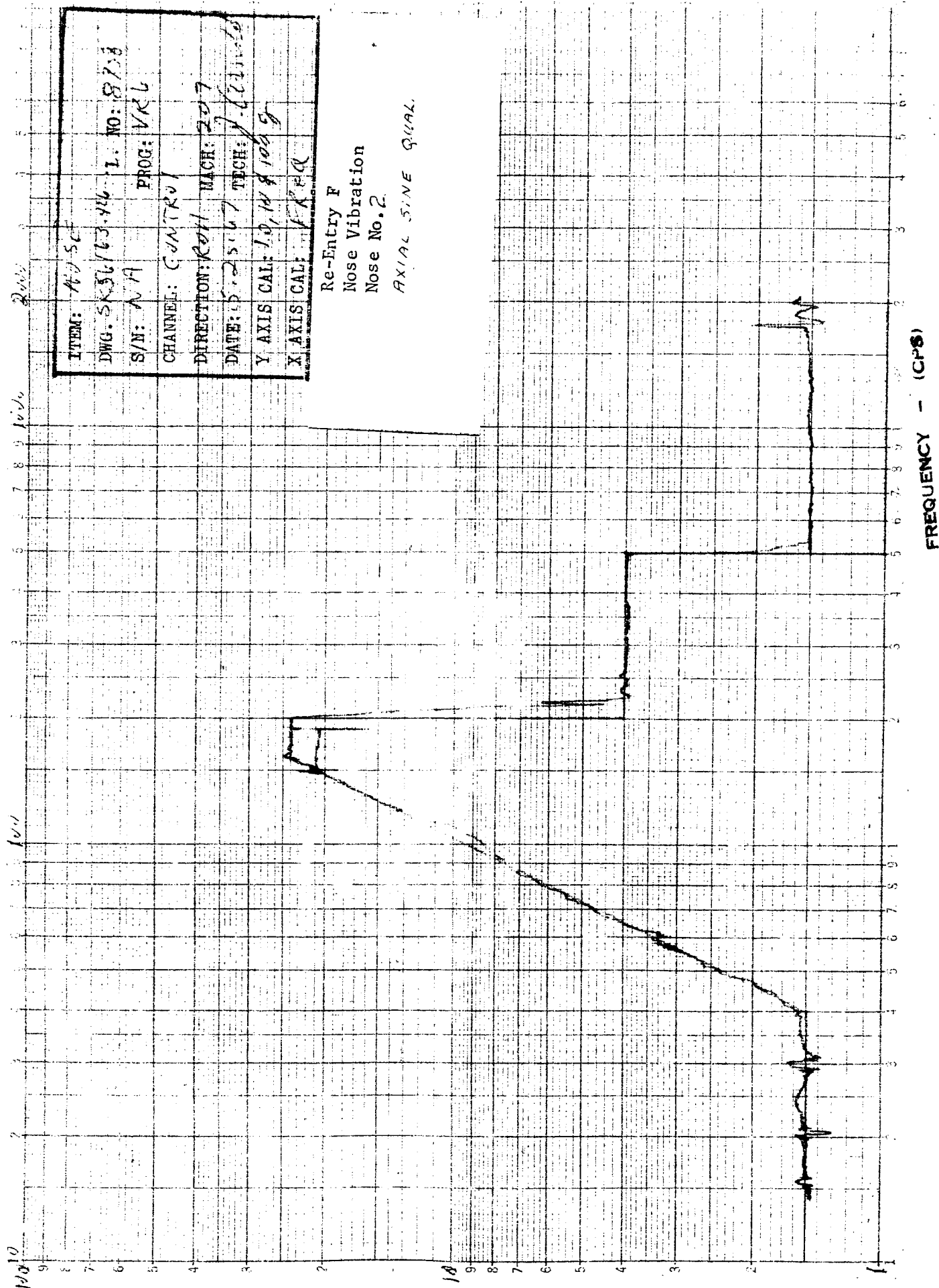
10

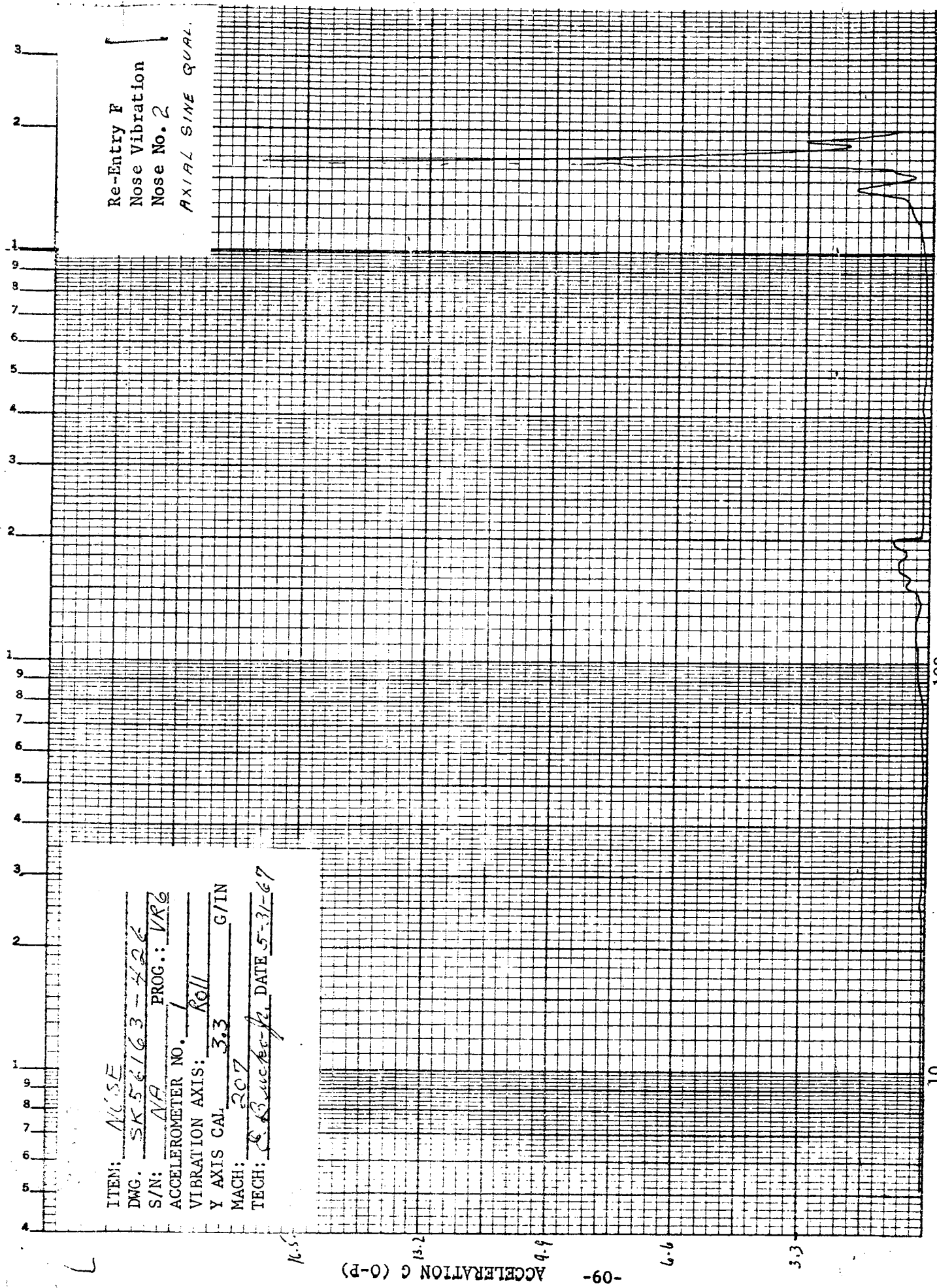
100





ITEM: Nose
 DWG: SK56163-426
 S/N: NA PROG.: VR6
 ACCELEROMETER NO.: 4
 VIBRATION AXIS: Roll
 Y AXIS CAL: 3.83 G/IN
 MACH: 2.07
 TECH: J. Williams DATE: 5.31.67





ITEM: Nose
 DWG. SK 56163-426
 S/N: NA PROG.: VR6
 ACCELEROMETER NO. 1
 VIBRATION AXIS: Roll
 Y AXIS CAL. 3.3 G/IN
 MACH: 207
 TECH: C. Buckner Jr. DATE 5-31-67

Re-Entry F
 Nose Vibration
 Nose No. 2
 AXIAL SINE QUAL.

Q. C. & T. VIBRATION LABORATORY

3 _____

2 _____

1 _____

9 _____

8 _____

7 _____

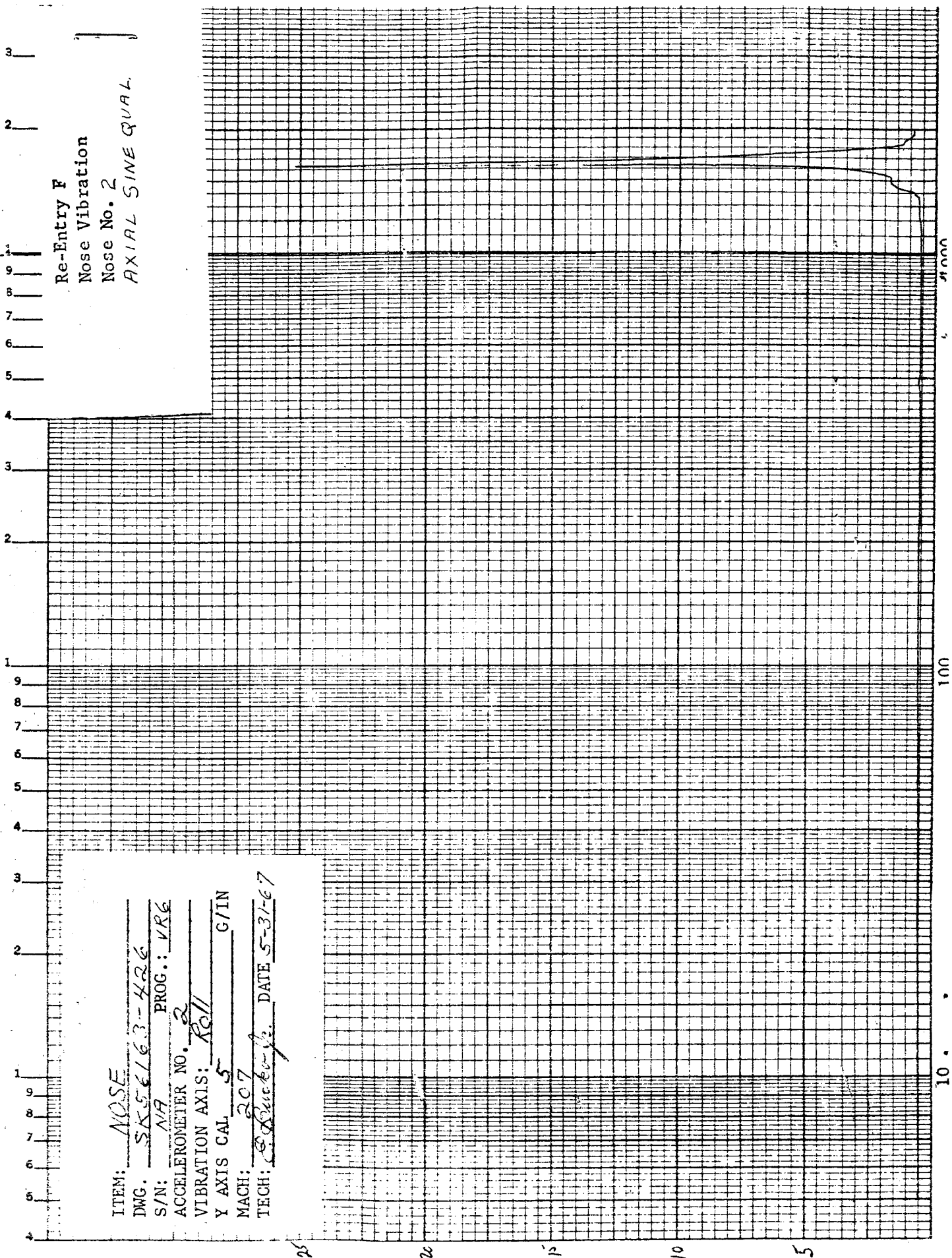
6 _____

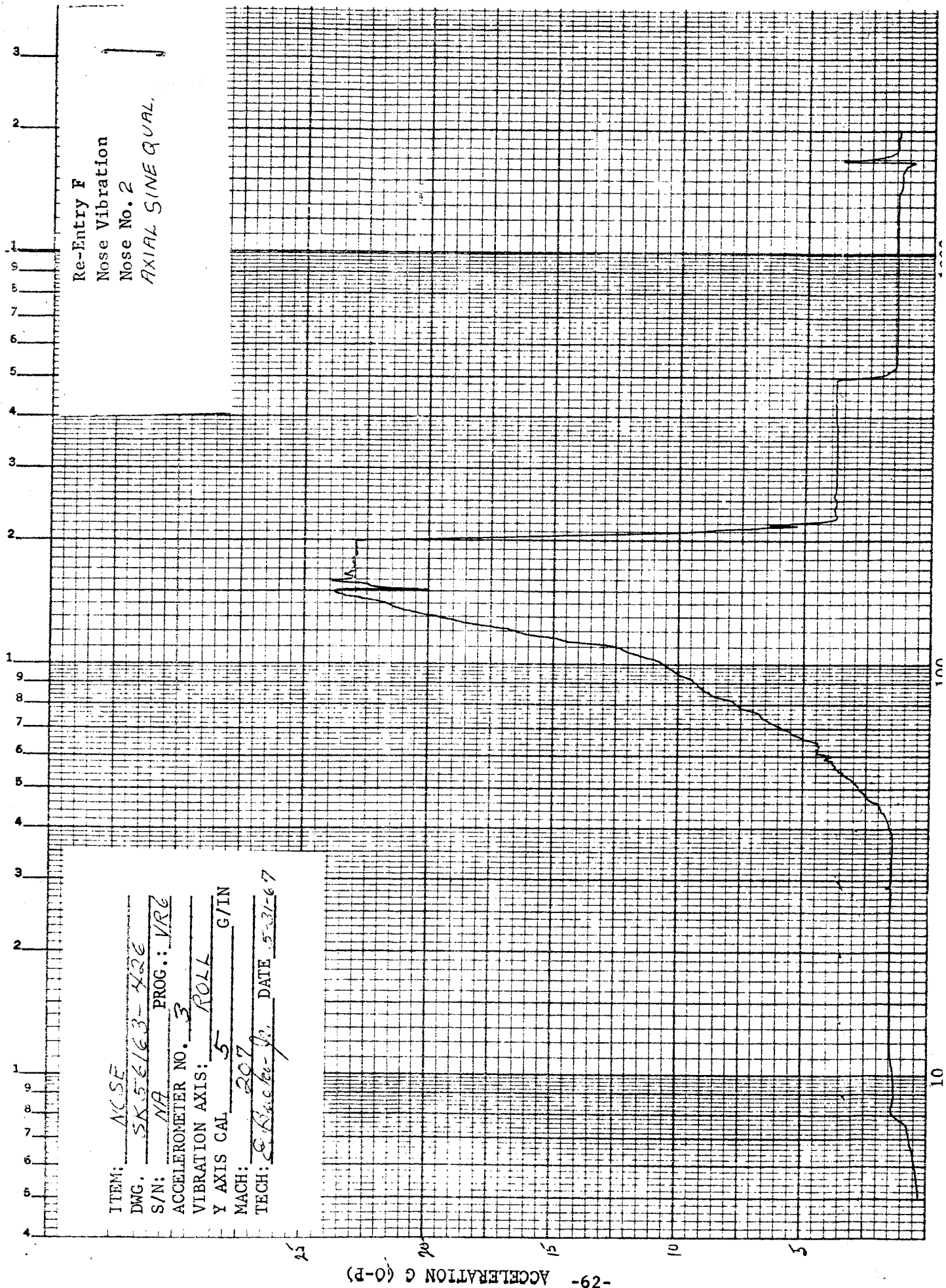
5 _____

Re-Entry F
Nose Vibration
Nose No. 2
AXIAL SINE QUAL.

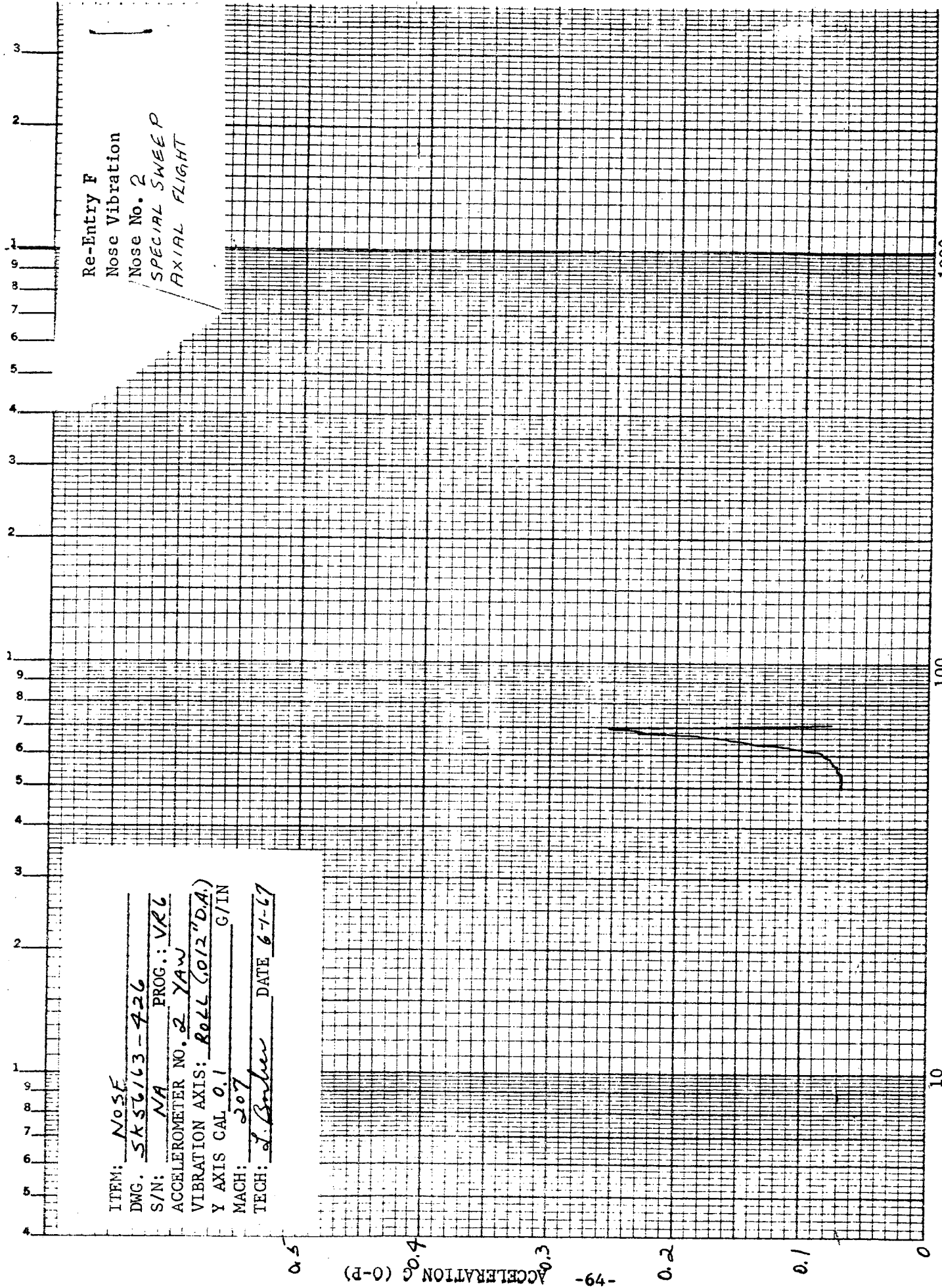
ITEM: NOSE
 DWG. SK56163-426
 S/N: N/A PROG.: VR6
 ACCELEROMETER NO. 2
 VIBRATION AXIS: Roll
 Y AXIS CAL. 5 G/IN
 MACH: 207
 TECH: G. Buckenb. DATE 5-31-67

ACCELERATION C (O-P)





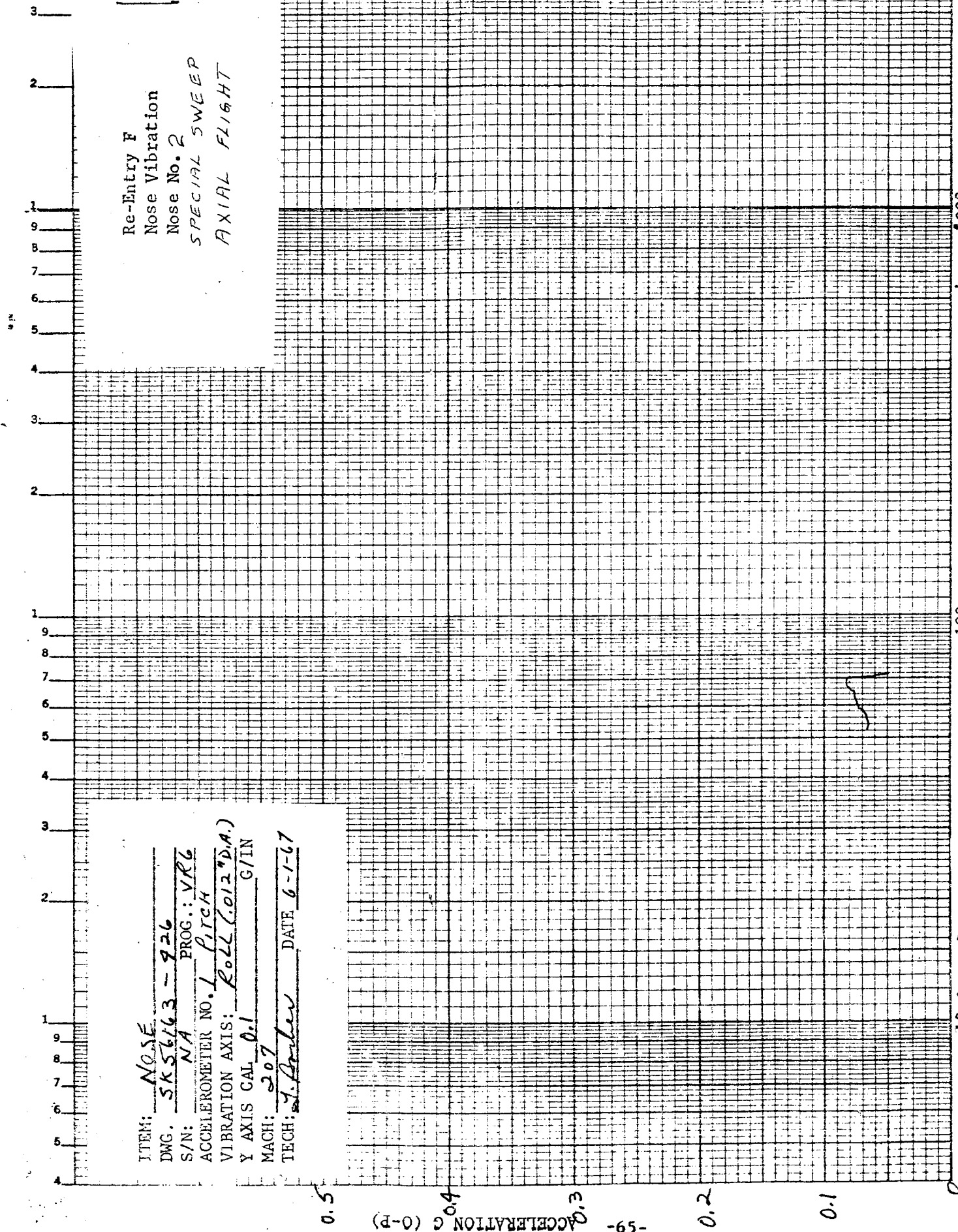
ITEM: NCSE
DWG. SK 56163-426
S/N: NA PROG.: VR6
ACCELEROMETER NO. 4
VIBRATION AXIS: Roll
Y AXIS CAL. 10 G/IN
MACH: 207
TECH: CC Buckner-Jr DATE 5-31-67



ITEM: Nose
 DWG: SK 56163-426
 S/N: NA PROG.: VR6
 ACCELEROMETER NO. 2 YAW
 VIBRATION AXIS: Roll (012" D.A.)
 Y AXIS CAL 0.1 G/IN
 MACH: 207
 TECH: L. Barker DATE 6-7-67

ACCELERATION (G) (O-P)

Q. C. & T. VIBRATION LABORATORY



Re-Entry F
Nose Vibration
Nose No. 2
SPECIAL SWEEP
AXIAL FLIGHT

ITEM: NOSE
DWG. SK56163-926
S/N: NA PROG.: VR6
ACCELEROMETER NO. 1 P17CH
VIBRATION AXIS: Roll (0.12"DA.)
Y AXIS CAL 0.1 G/IN
MACH: 207
TECH: T. Parker DATE 6-1-67

0.5

ACCELERATION G (0-P)

0.4

0.3

-59-

0.2

0.1

0

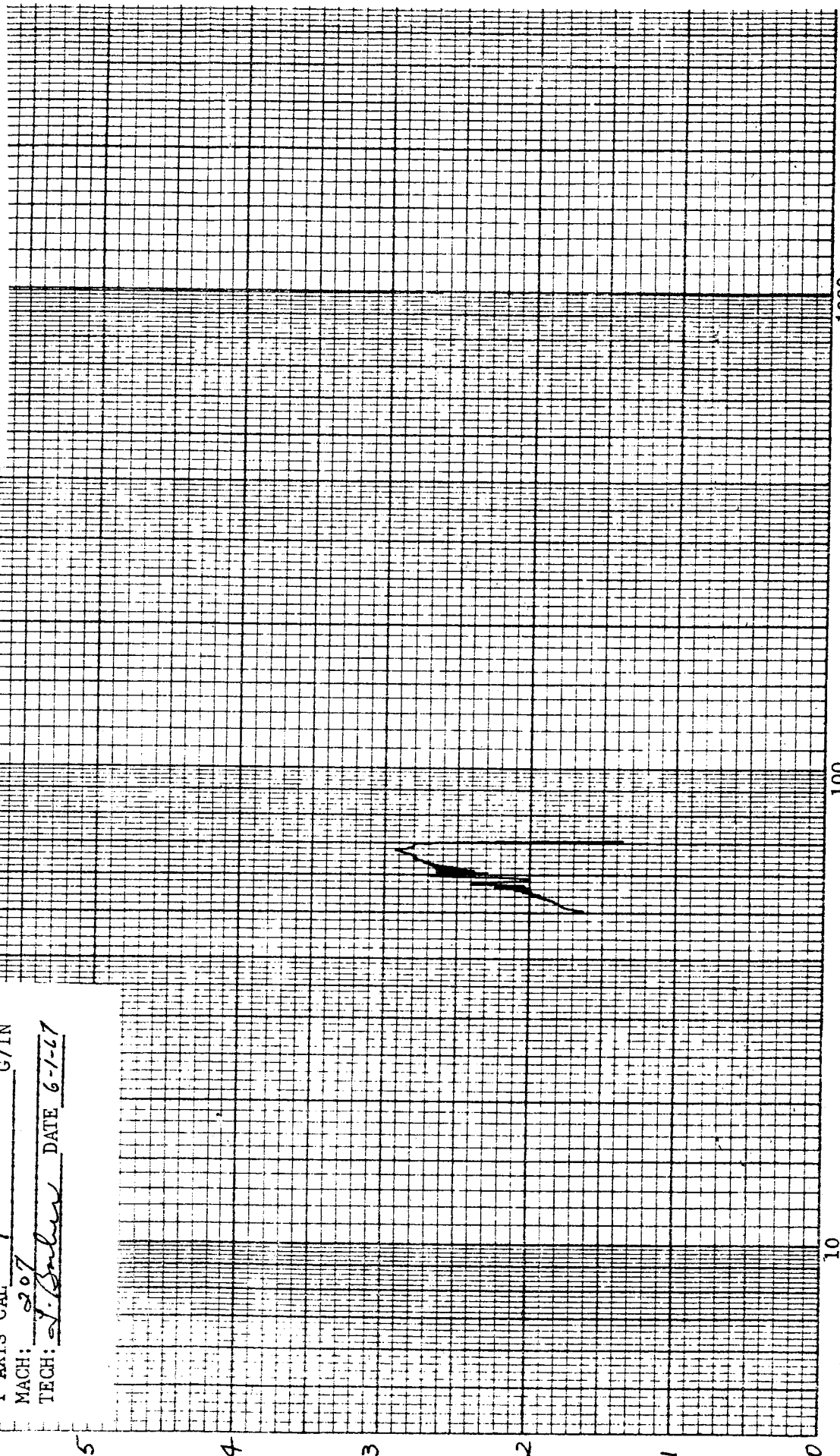
3
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Re-Entry F
Nose Vibration
Nose No. 2
SPECIAL SWEEP
AXIAL FLIGHT

4
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ITEM: NOSE
DWG: SK 56163-926
S/N: NA
ACCELEROMETER NO. 3 ROLL
VIBRATION AXIS: ROLL (.012" D.A.)
Y AXIS CAL 1 G/IN
MACH: 207
TECH: J. Barber DATE 6-1-67





Re-Entry F
Nose Vibration
Nose No. 2
SPECIAL SWEEP
AXIAL FLIGHT

ITEM: NOSE
DWG. 5556163-426
S/N: NA
ACCELEROMETER NO. 4 NOSE
VIBRATION AXIS: Roll (012" D.A.)
Y AXIS CAL 1 G/IN
MACH: 207
TECH: J. Barber DATE 6-1-67

ITEM: NOSE
DWG. SK 56163-926
S/N: NA PROG.: VR6
ACCELEROMETER NO. 1 PITCH
VIBRATION AXIS: ROLL 6018° D.A.
Y AXIS CAL 0.1 G/IN
MACH: 207
TECH: L. Barker DATE 6-6-67
SPECIAL SWEEP

SPECIAL SWEEP

ACCELERATION G (O-P)

-68-

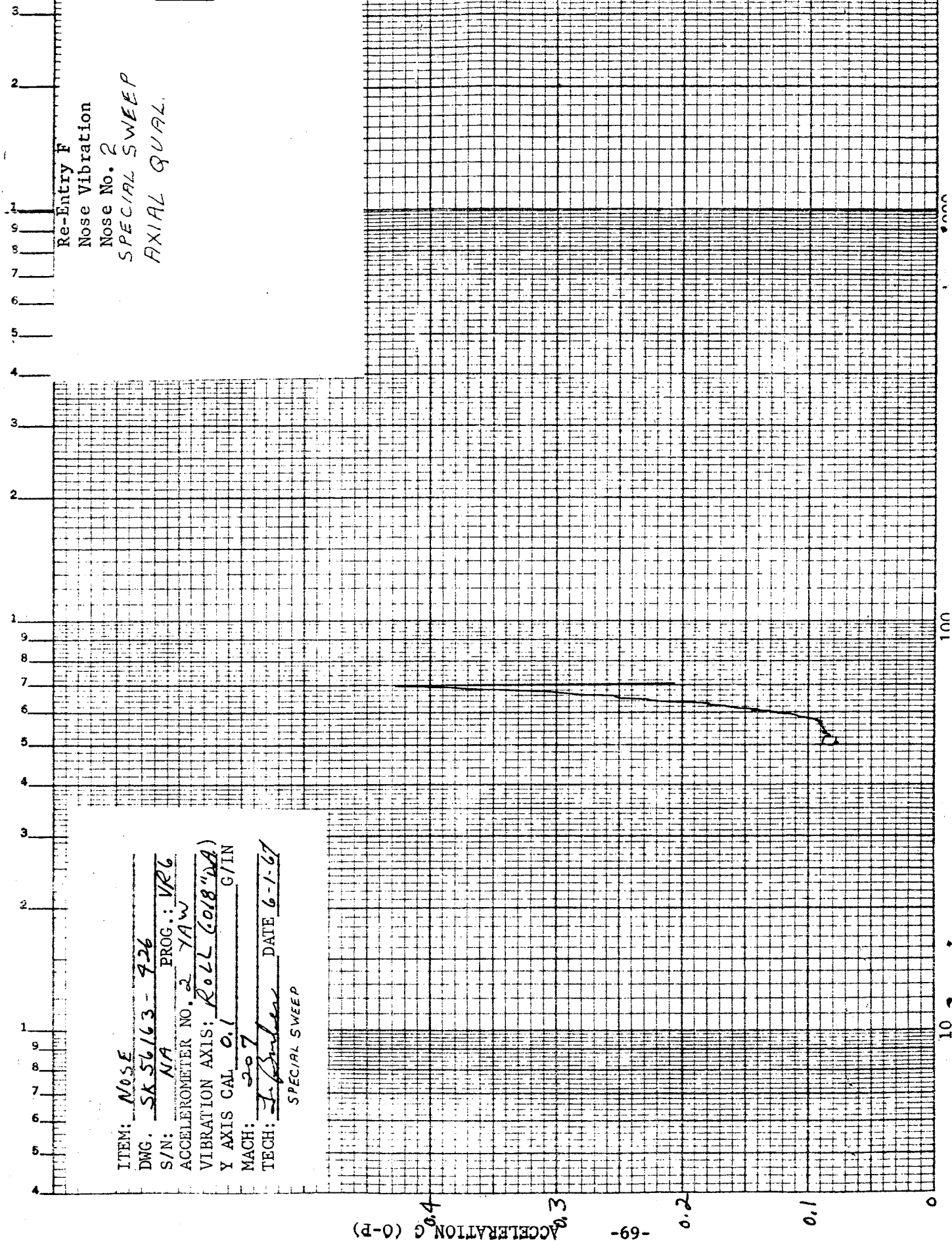
0.2.

0.1

10

100

九



ITEM: Nose
 DWG: SK 56163-426
 S/N: NA PROG.: VR6
 ACCELEROMETER NO. 2 YAW
 VIBRATION AXIS: ROLL (018"DA)
 Y AXIS CAL 0.1 G/IN
 MACH: 207
 TECH: J. B. Baker DATE 6-1-67
 SPECIAL SWEEP

Re-Entry F
Nose Vibration
Nose No. 2
SPECIAL SWEEP
AXIAL QUAL.

ITEM: NOSE
DWG. 5A 56163-426
S/N: NA
ACCELEROMETER NO. 3
VIBRATION AXIS: Roll (.018" D.A.)
Y AXIS CAL 1 G/IN
MACH: 207
TECH: J. Barber DATE 6-1-67
SPECIAL SWEEP

-70- ACCELERATION G (0-P)

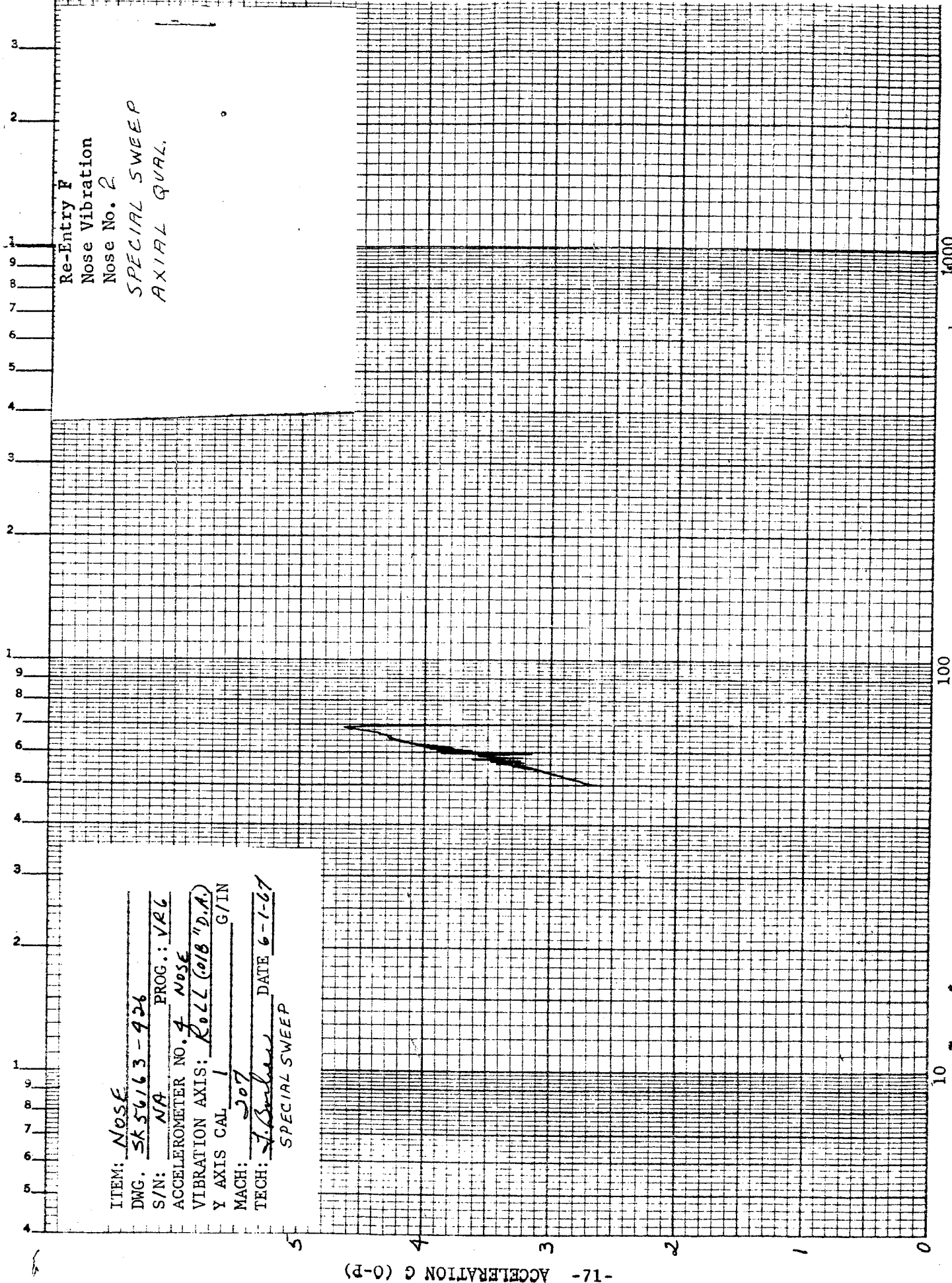
1000

100

10

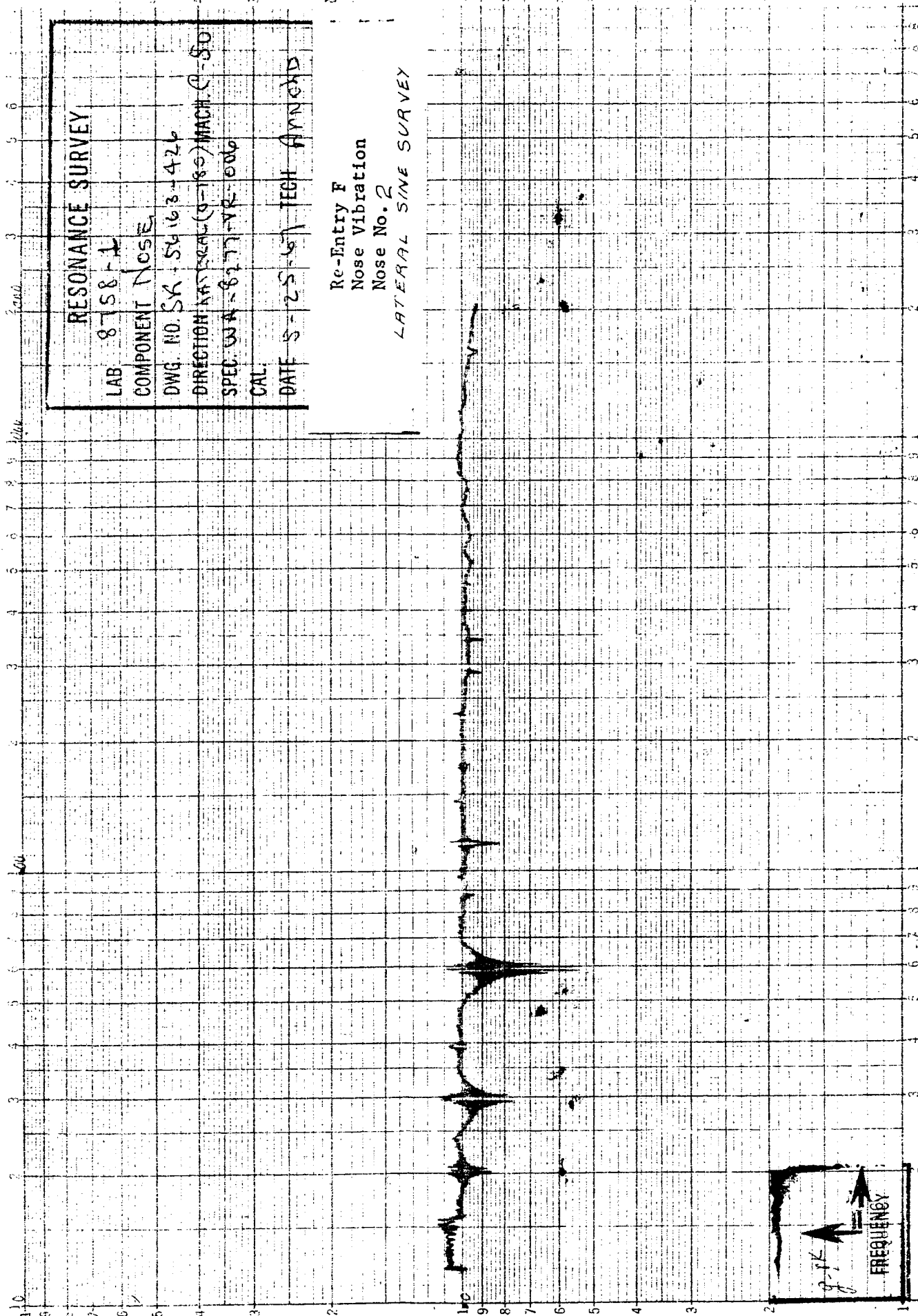
0

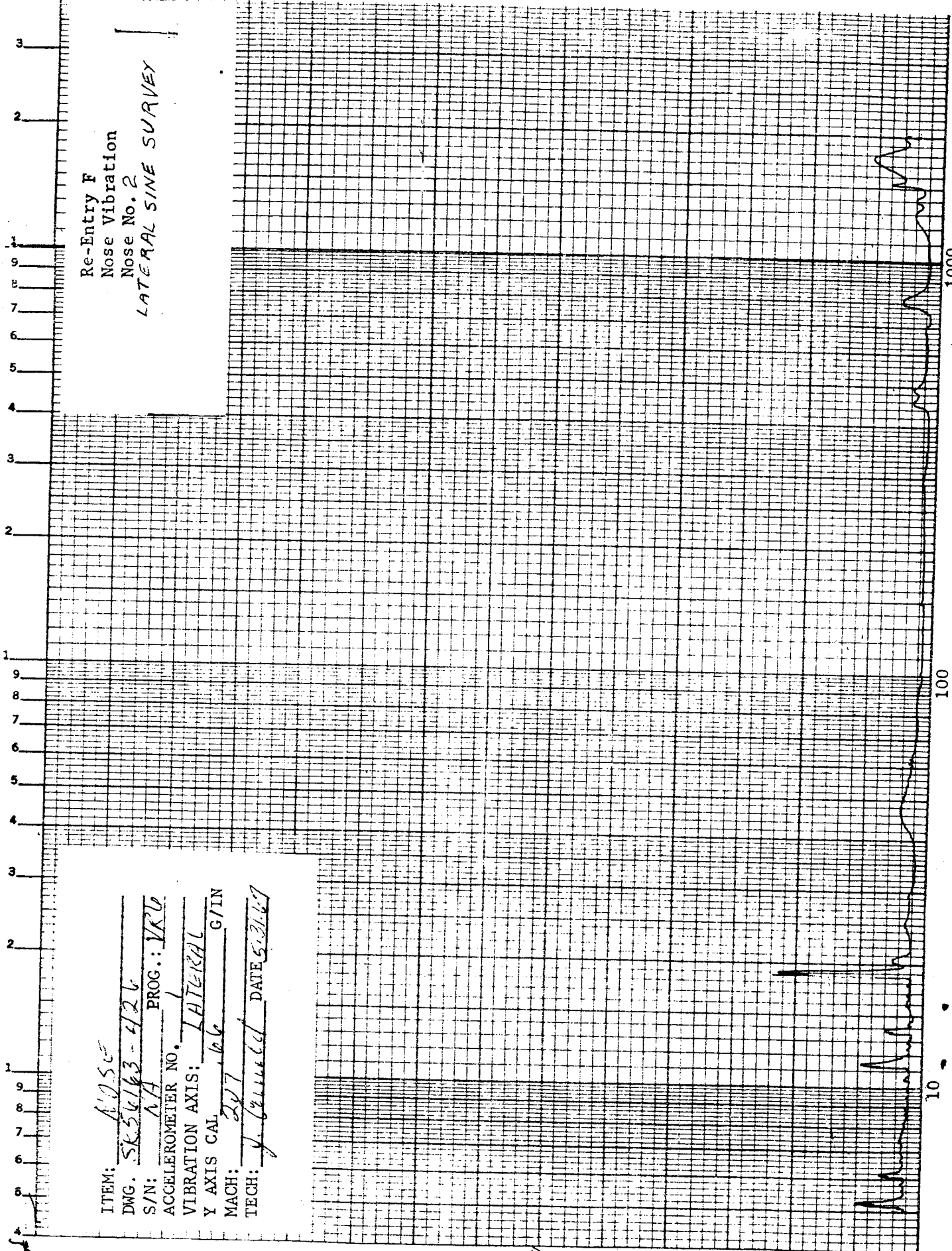
Q. C. & T. VIBRATION LABORATORY



Re-Entry F
Nose Vibration
Nose No. 2
SPECIAL SWEEP
AXIAL QUAL.

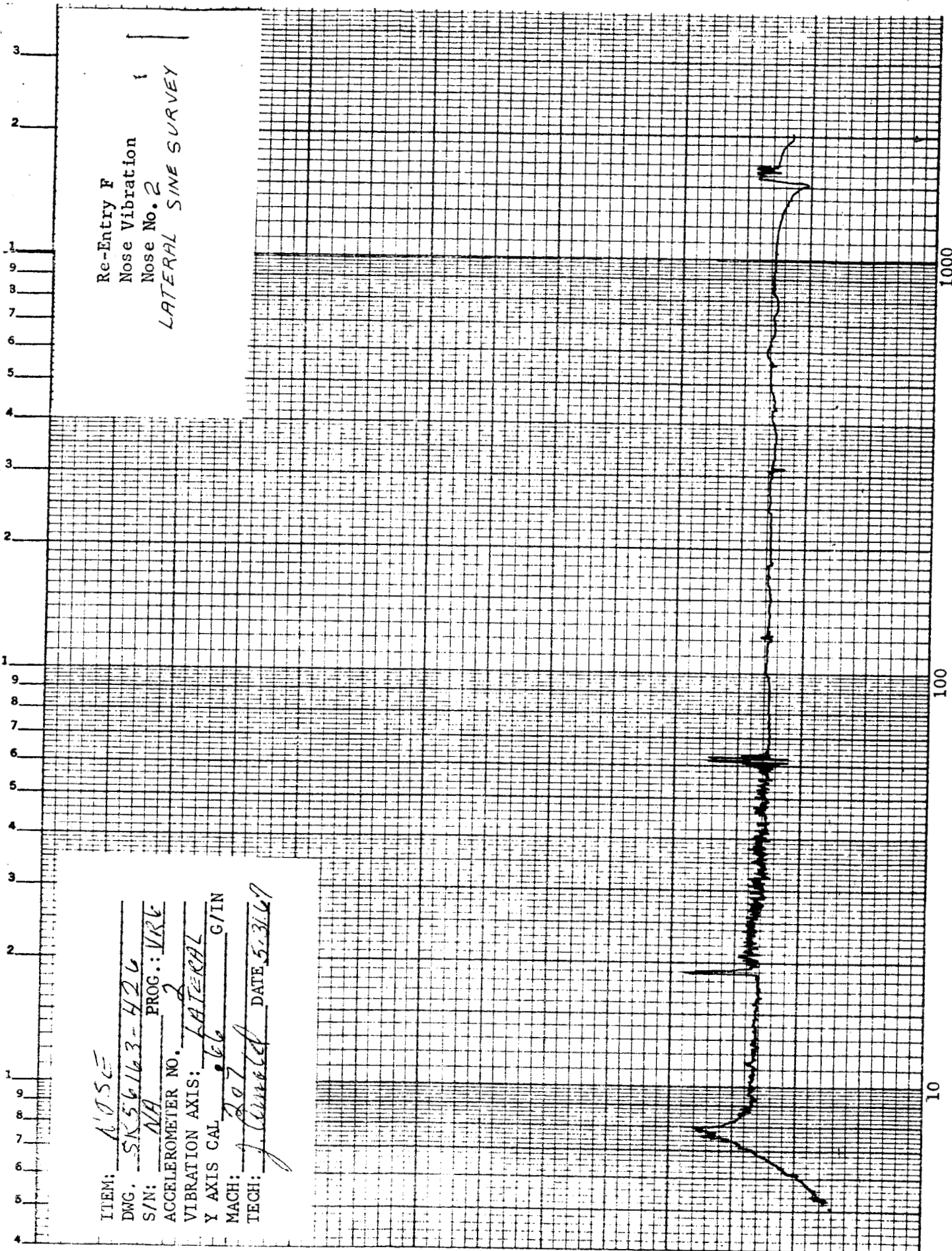
ITEM: Nose
DWG. SK 56163-926
S/N: N/A PROG.: VR6
ACCELEROMETER NO. 4 Nose
VIBRATION AXIS: ROLL (018 "D.A.)
Y AXIS CAL 1 G/IN
MACH: 207
TECH: J. Burlew DATE 6-1-67
SPECIAL SWEEP





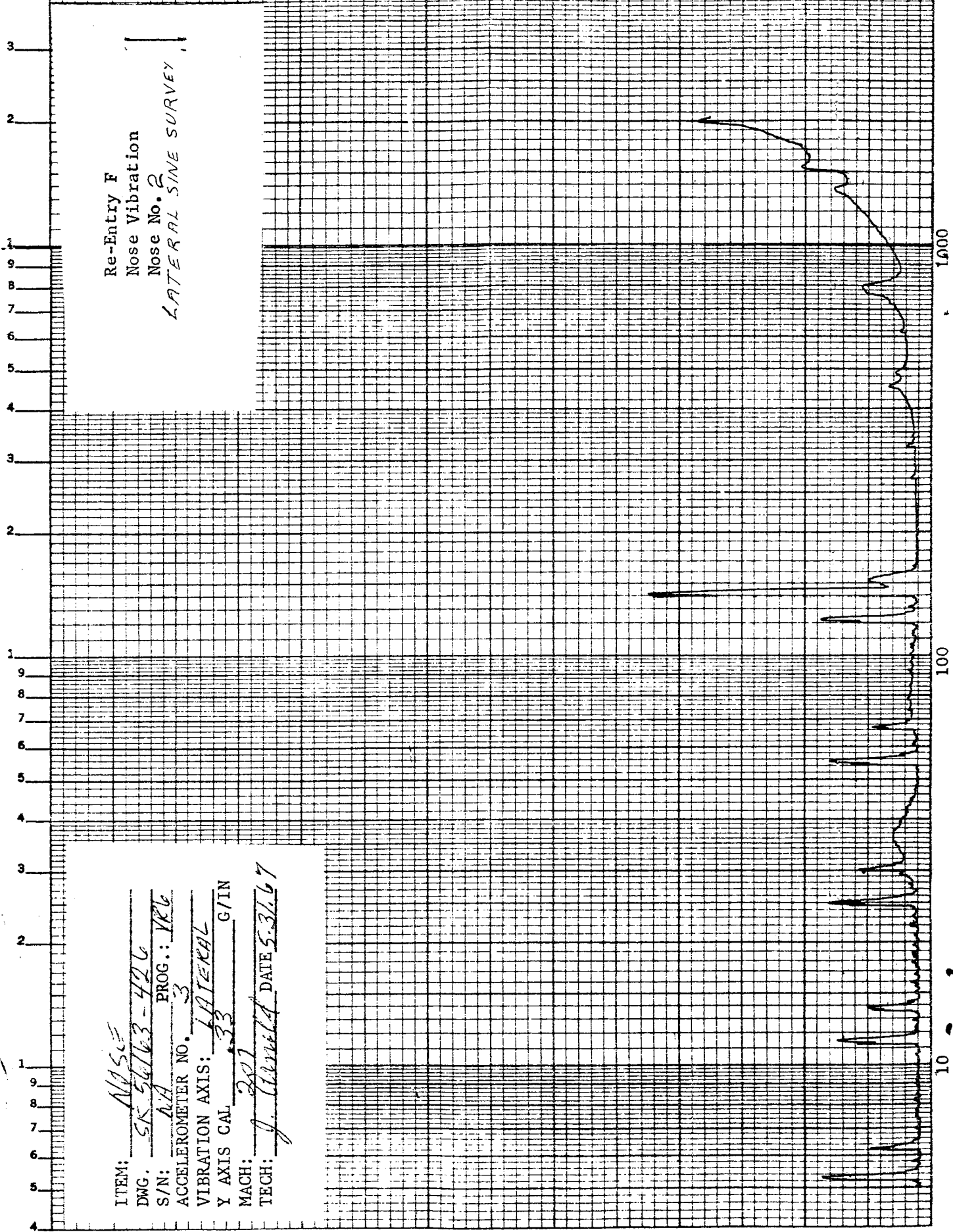
Re-Entry F
Nose Vibration
Nose No. 2
LATERAL SINE SURVEY

ITEM: N050
DWG. SK56163-4126
S/N: NA PROG.: VR6
ACCELEROMETER NO. 1
VIBRATION AXIS: LATERAL
Y AXIS CAL. 207.166 G/IN
MACH: 207
TECH: J. Gammell DATE 5/31/67



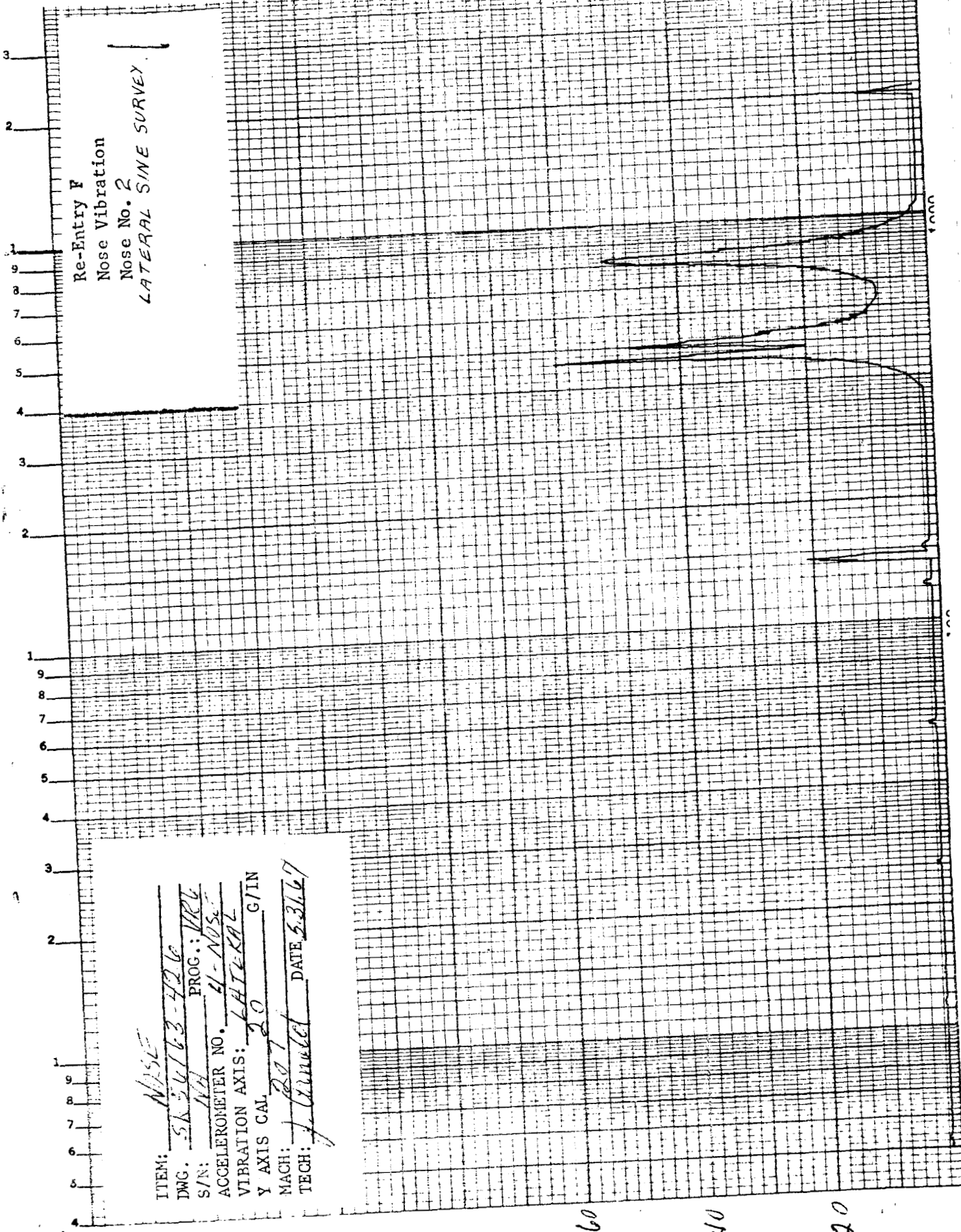
Re-Entry F
Nose Vibration
Nose No. 2
LATERAL SINE SURVEY

ITEM: 105E
DWG. SK 56163-426
S/N: NA PROG.: VR6
ACCELEROMETER NO. 2
VIBRATION AXIS: LATERAL
Y AXIS CAL 0.66 G/IN
MACH: 207
TECH: J. Arnold DATE 5.31.69



ITEM: 1151
 DWG. SK 56163-426
 S/N: 411 PROG.: VR6
 ACCELEROMETER NO. 3
 VIBRATION AXIS: LATERAL
 Y AXIS CAL. 33 G/IN
 MACH: 201
 TECH: J. Arnold DATE 5.31.67

ITEM: N1102
DWG. 5454163-426
S/N: N/A PROG.: NR6
ACCELEROMETER NO. 21-N052
VIBRATION AXIS: LATE-KAL
Y AXIS CAL. 20 G/IN
MACH: 201
TECH: J. Grunfeld DATE: 5.31.67



Re-Entry F

Nose No 2

Nose Vibration

LATERAL Direction

Random Qual Assurance

Lead No. INPUT

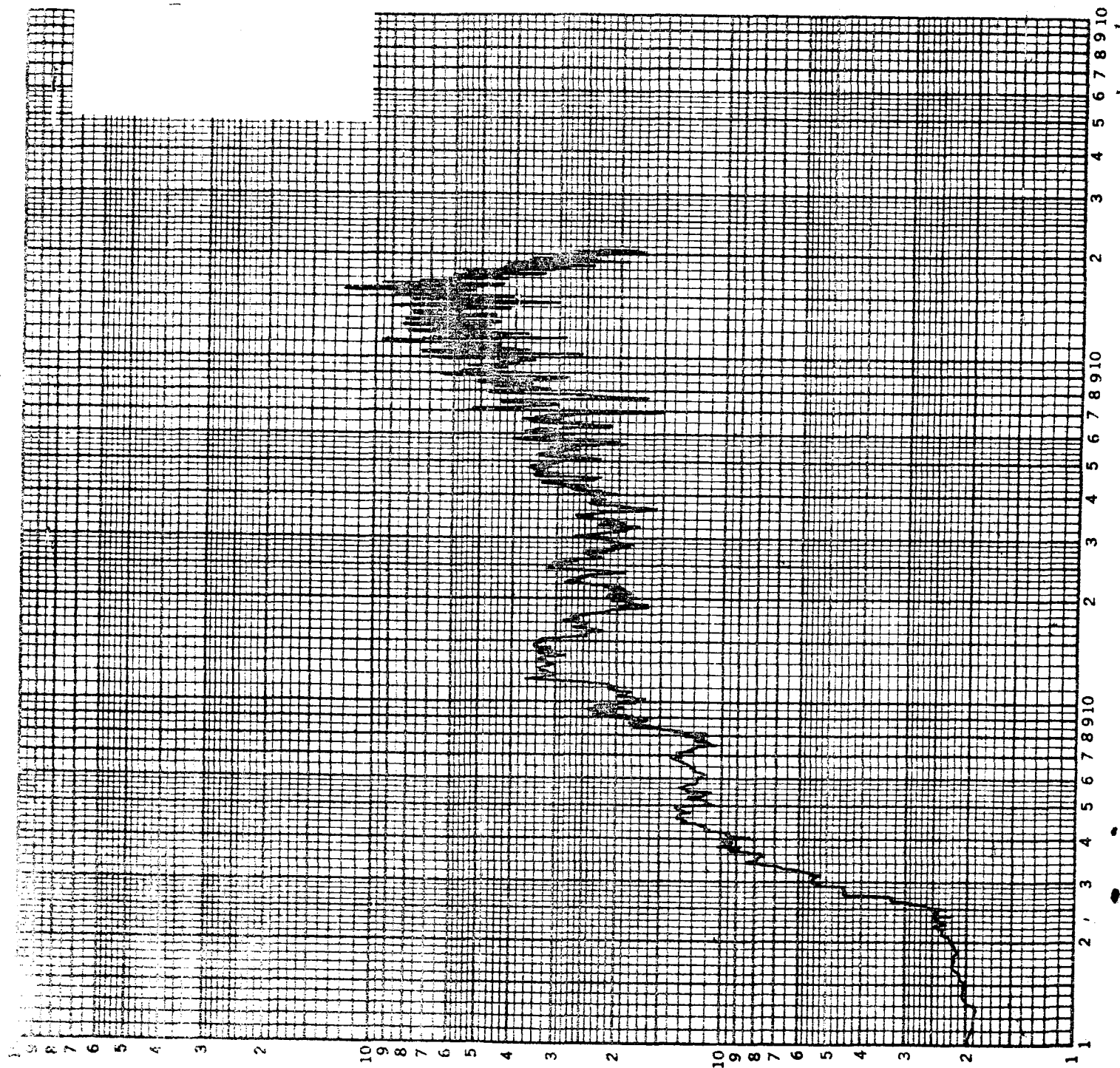
Overall Level = 10.6 G RMS

1.06 γ /sec FULL SCALE

Filter Bandwidth

5Hz to 100Hz

20Hz to 2KHz



Re-Entry F

Nose No. 2

Nose Vibration

LATERAL Direction

Random Qual

Lead No. 4

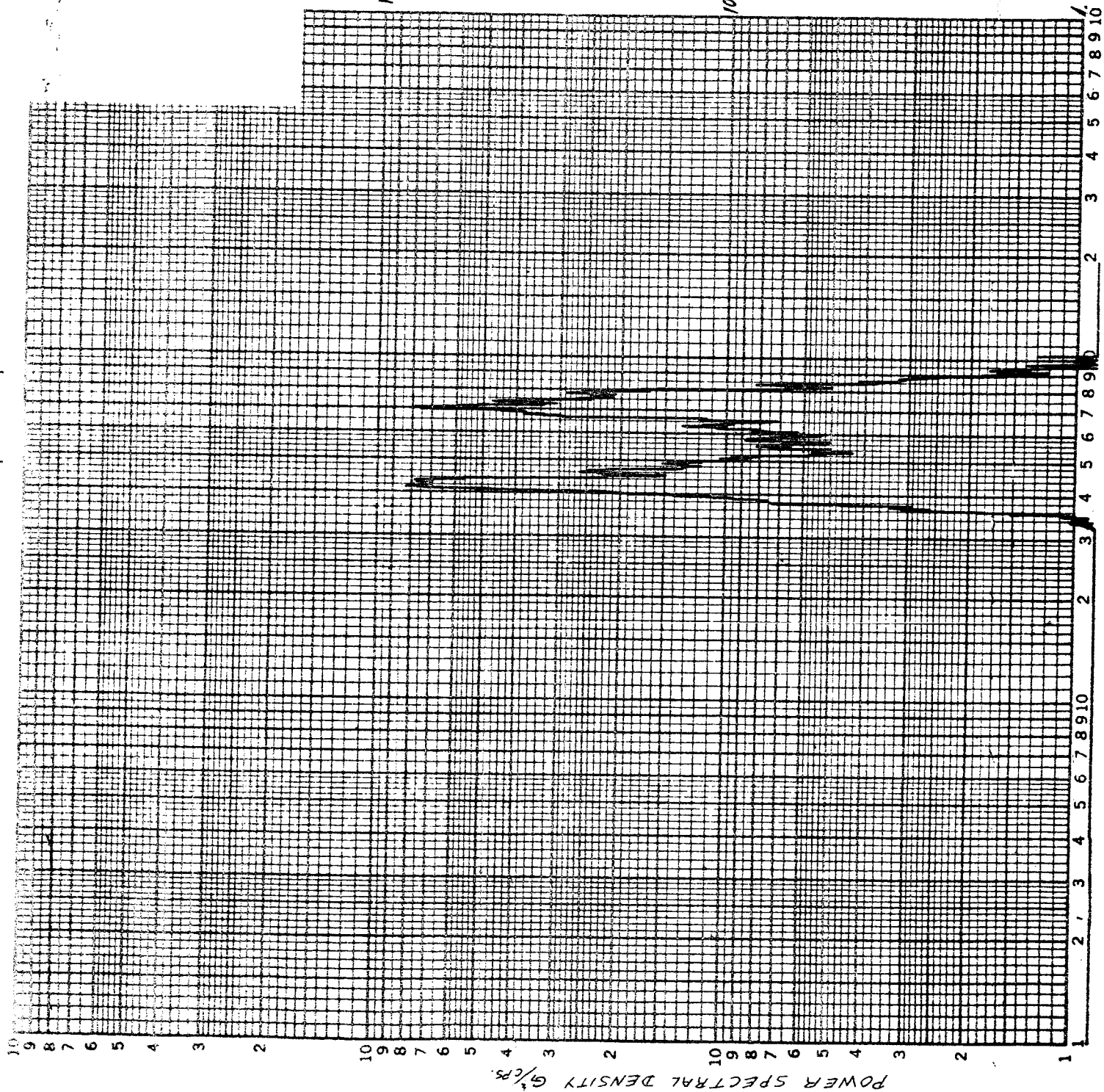
Overall Level = 109 G_r(R)

1000 G²/G_z FULL SCALE

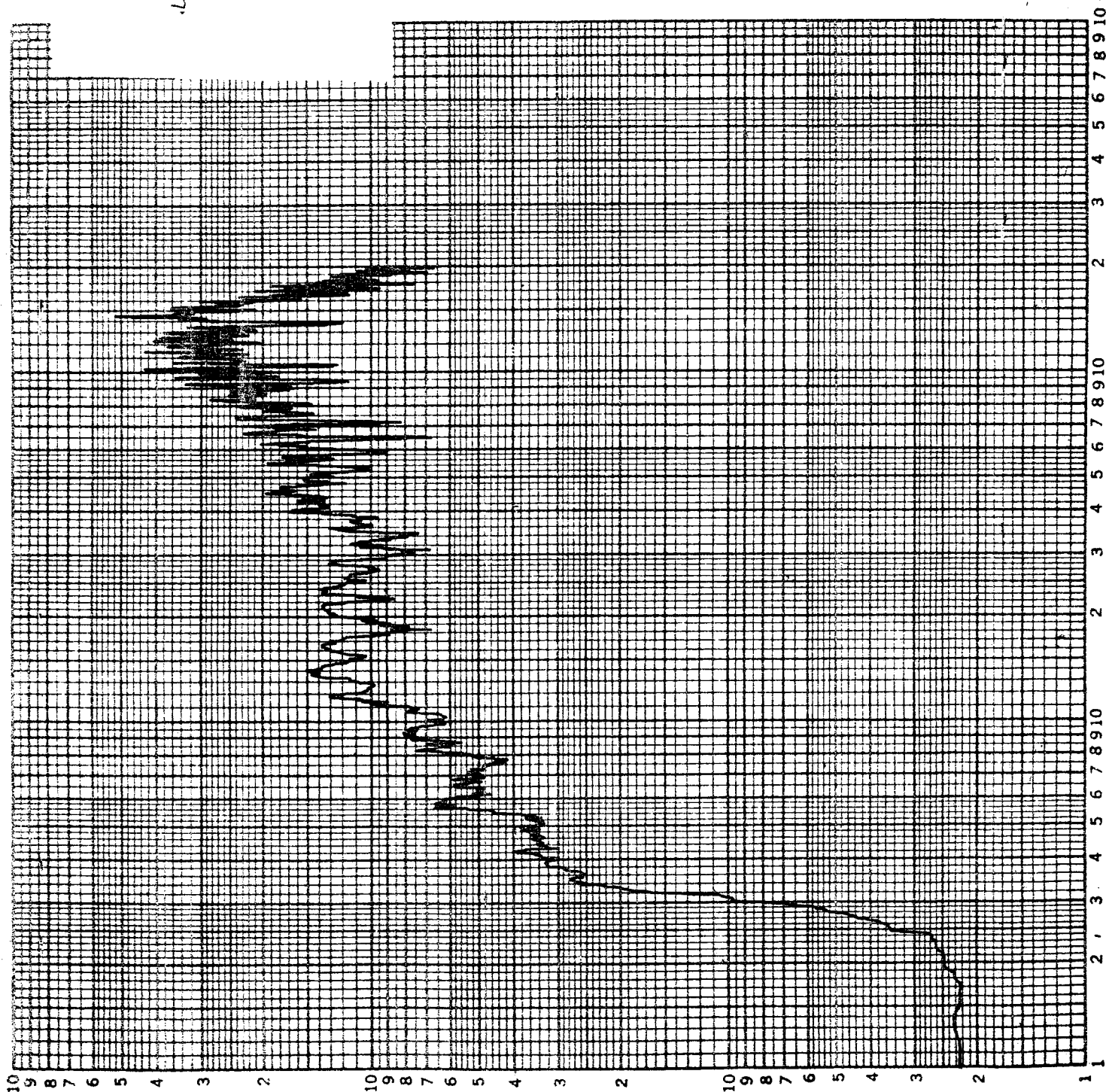
Filter Bandwidth

5Hz to 100Hz

20Hz to 2KHz



Re-Entry F
 Nose No. 2
 Nose Vibration
 LATERAL Direction
 Random Flight Assurance
 Lead No. *INPUT*
 Overall Level = *17.0 GR*
.16 g's FULL SCALE
 Filter Bandwidth
 5Hz to 100Hz
 20Hz to 2KHz



Re-Entry F

Nose No. 2

Nose Vibration

LATERAL Direction

Random Flight Assurance

Lead No. 4

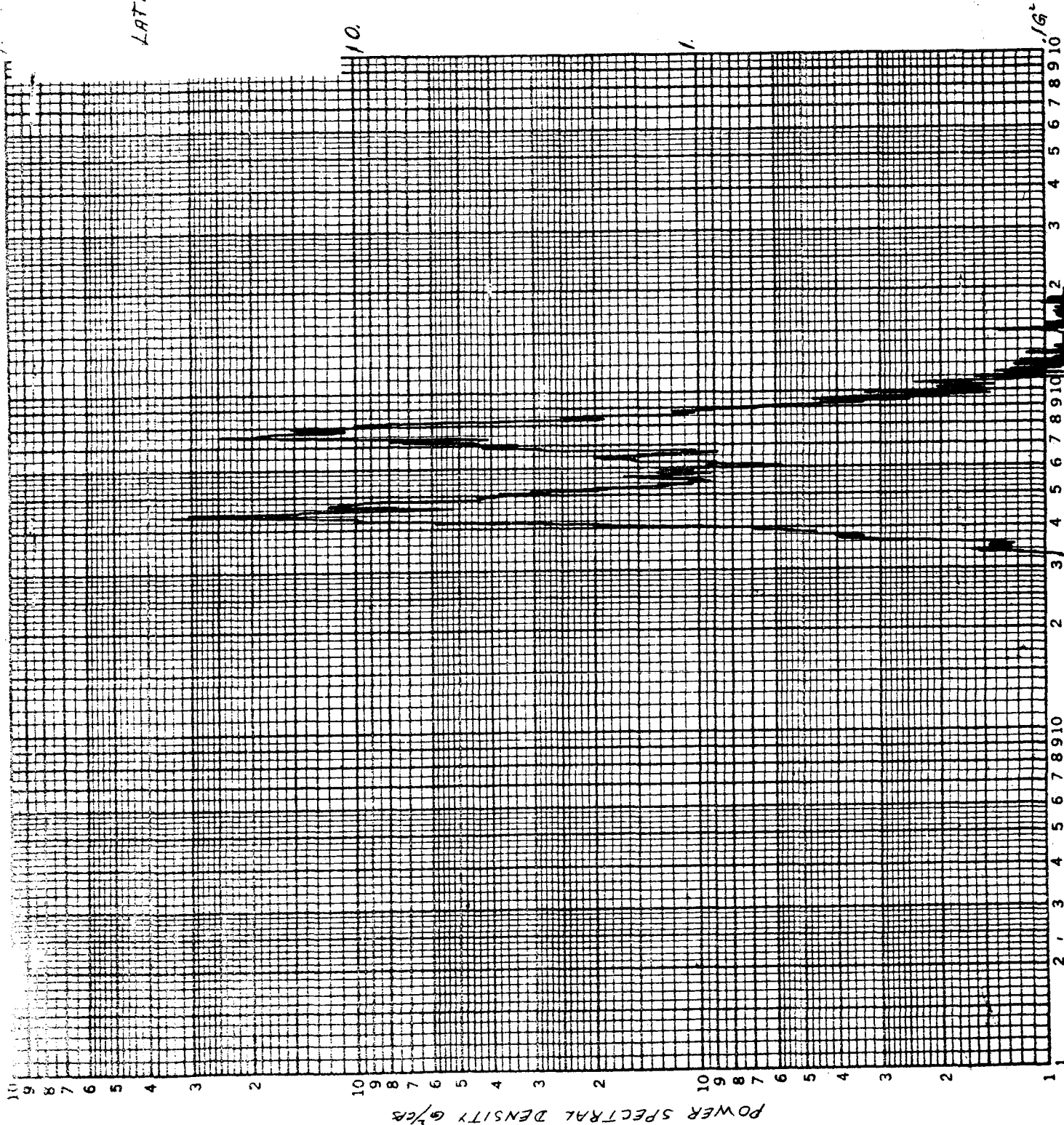
Overall Level = 57.6 g_{rms}

100.6% FULL SCALE

Filter Bandwidth

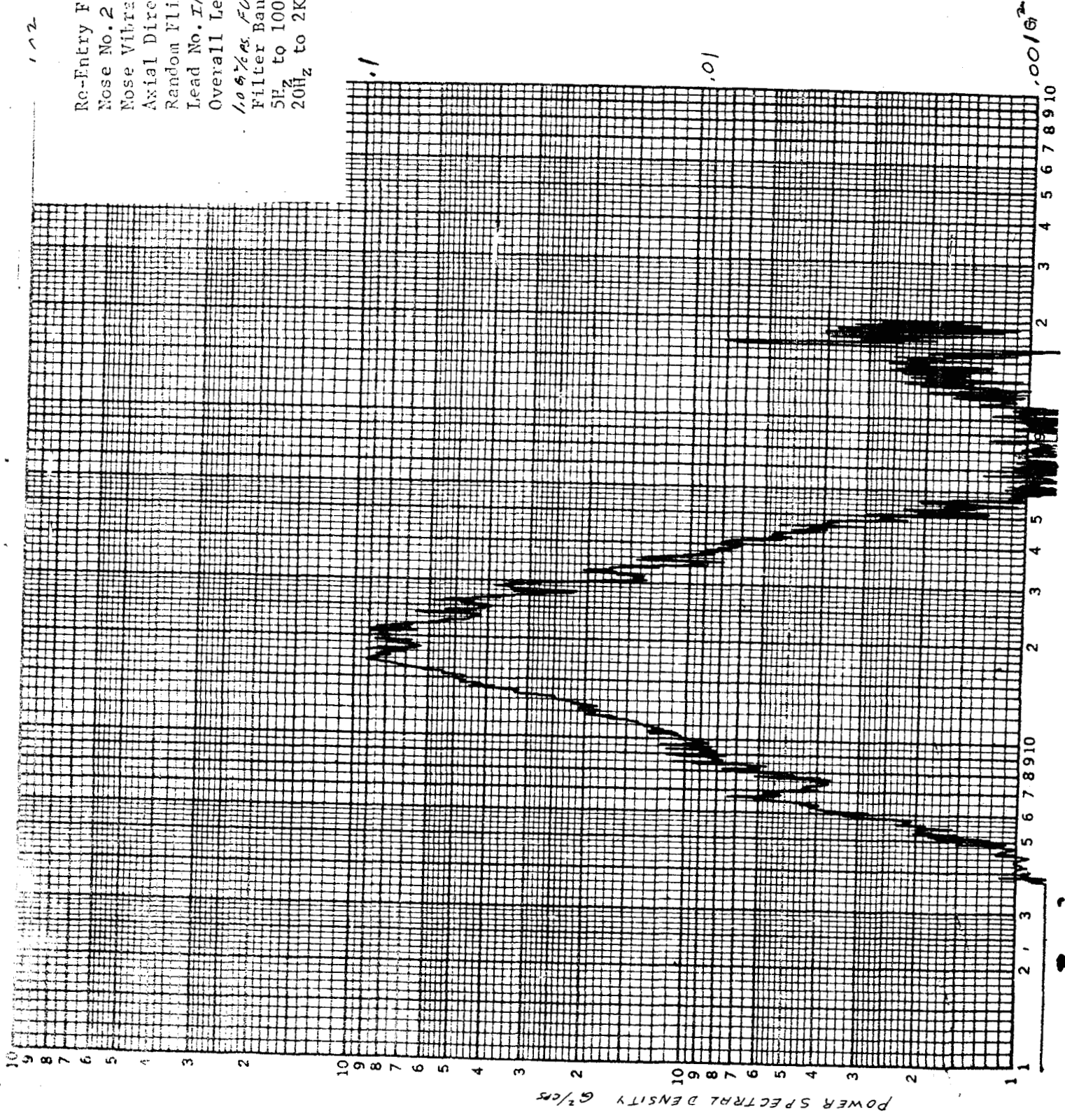
5Hz to 100Hz

20Hz to 2KHz

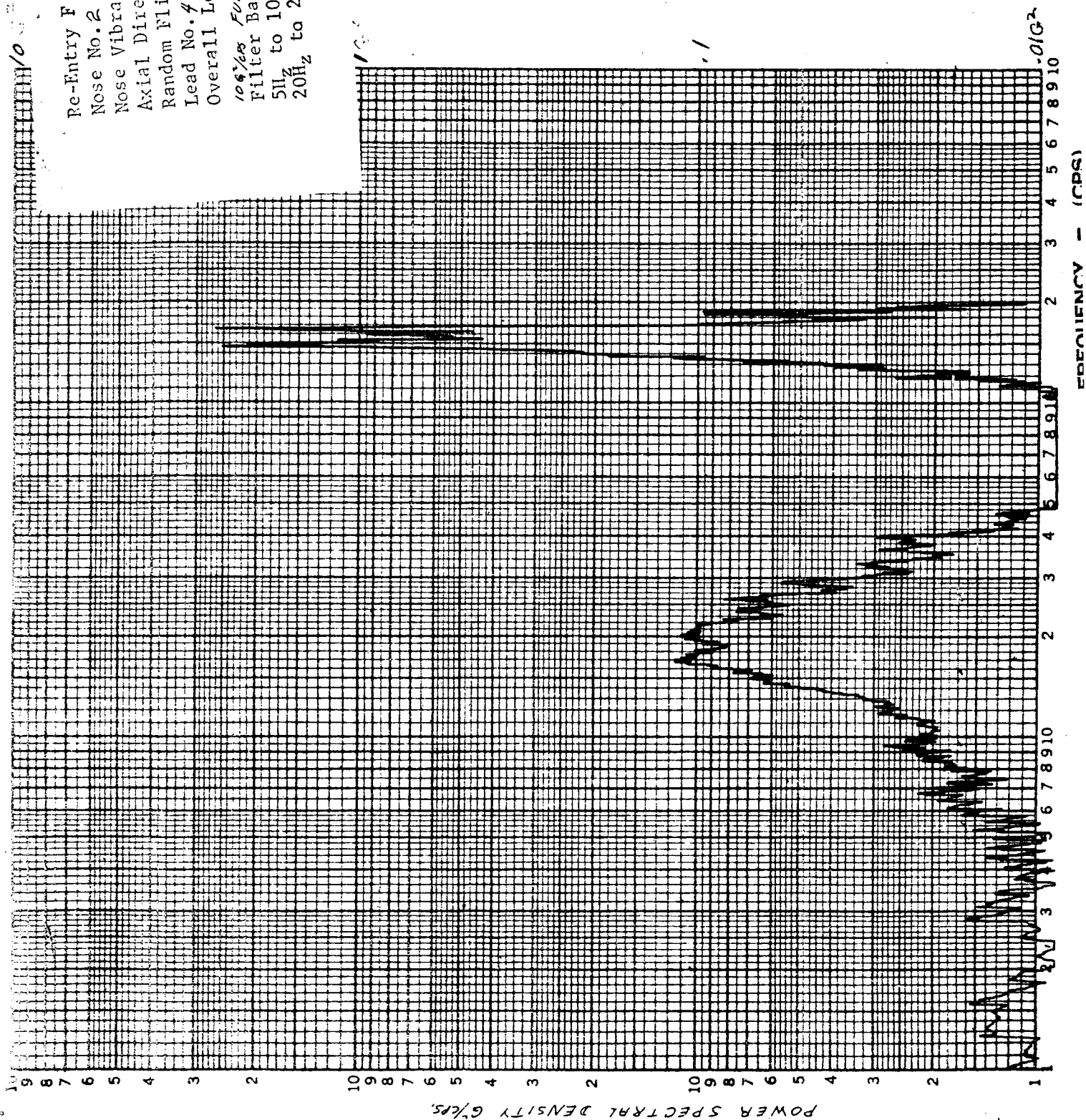


112

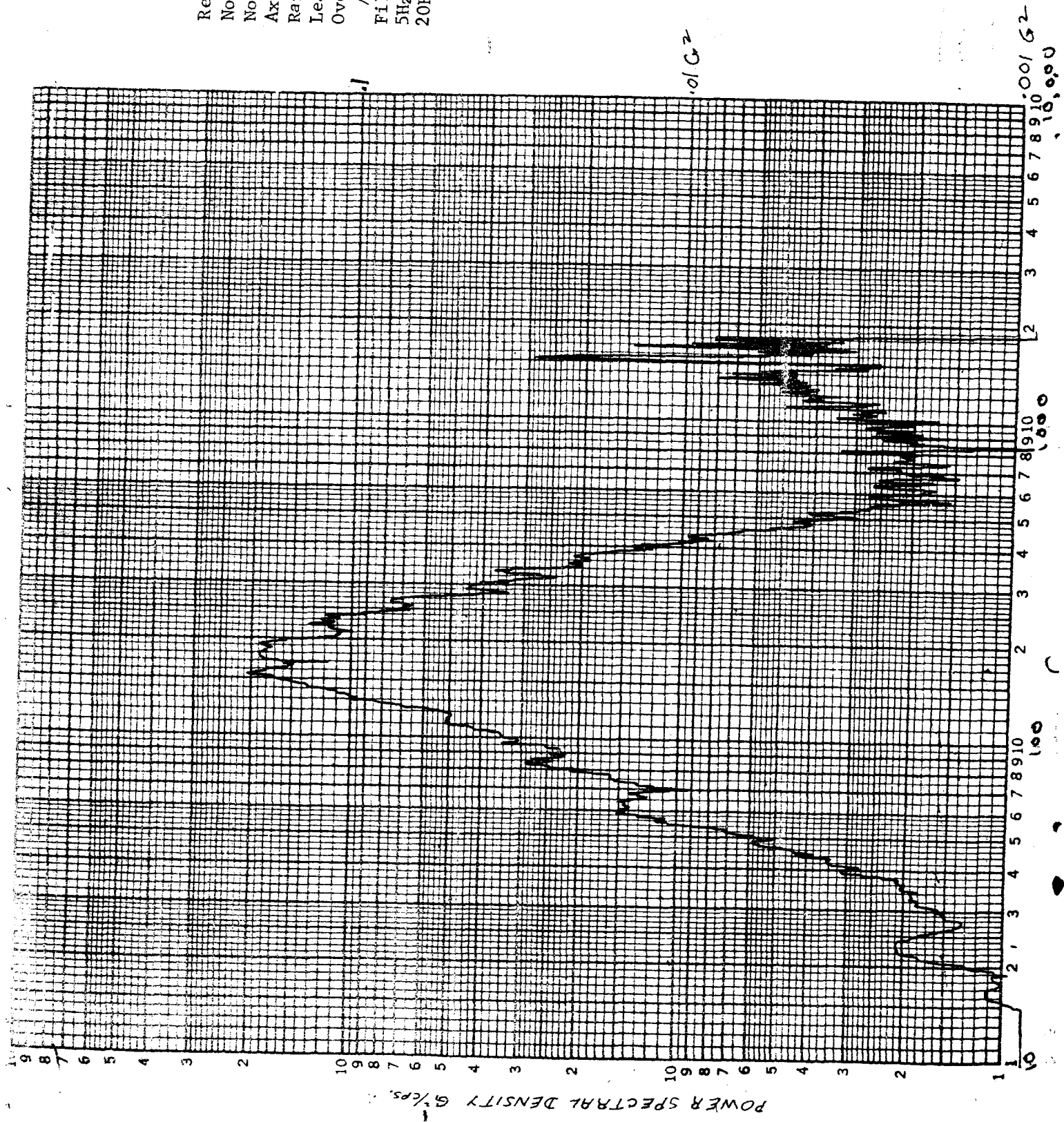
Re-Entry F
Nose No. 2
Nose Vibration
Axial Direction
Random Flight Assurance
Lead No. INPUT
Overall Level = 3.86 (RMS)
1.06% FS FULL SCALE
Filter Bandwidth
5Hz to 100Hz
20Hz to 2KHz



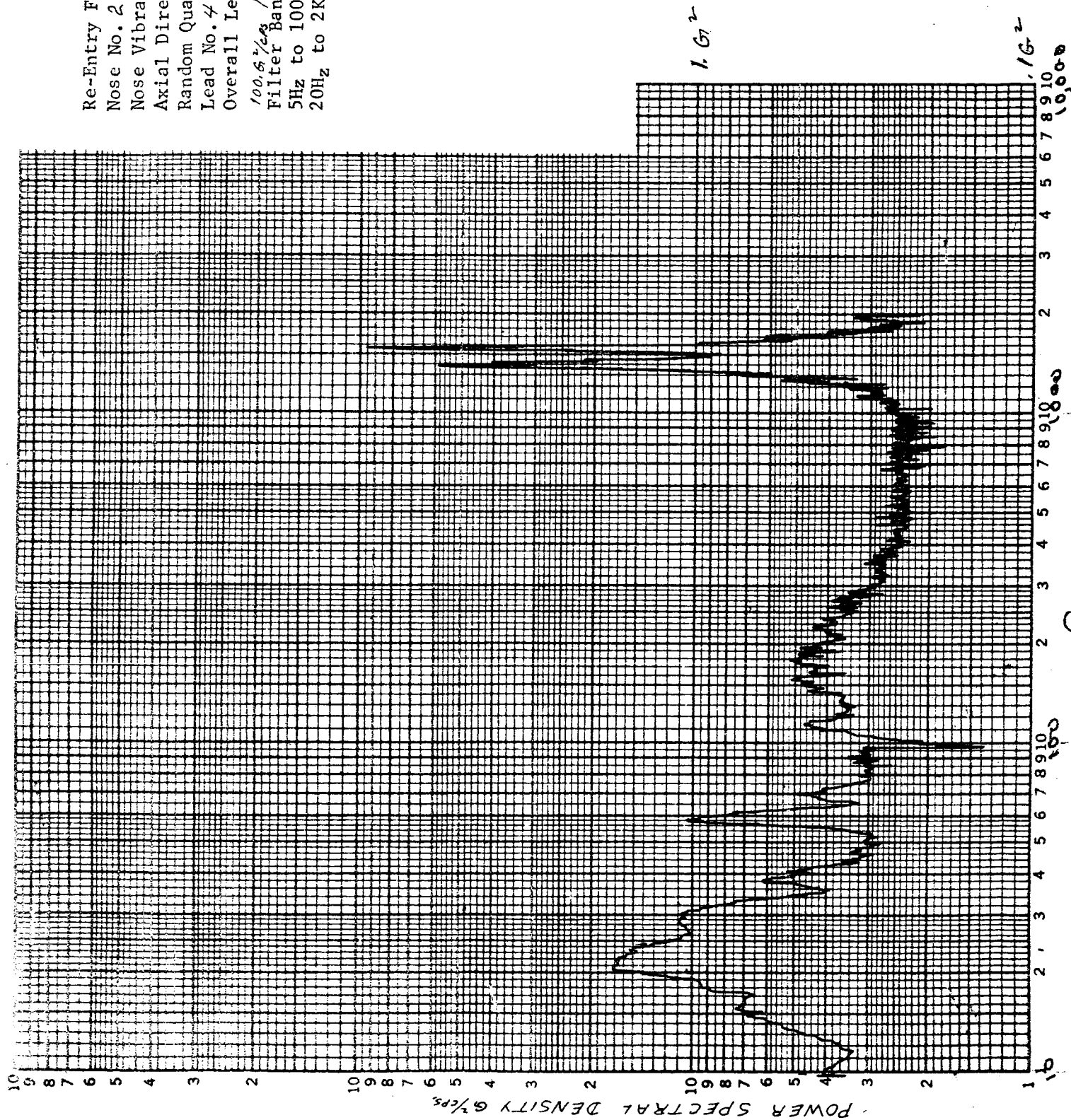
Re-Entry F
 Nose No. 2
 Nose Vibration
 Axial Direction
 Random Flight Assurance
 Lead No. 4
 Overall Level = 17.66 (rms.)
 106% FS FULL SCALE
 Filter Bandwidth
 5Hz to 100Hz
 20Hz to 2KHz



Re-Entry F
 Nose No. 2
 Nose Vibration
 Axial Direction
 Random Qual
 Lead No. INPUT
 Overall Level = 6.16 (RMS)
 1.0 G²/GAS FULL SCALE
 Filter Bandwidth
 5Hz to 100Hz
 20Hz to 2KHz



Re-Entry F
 Nose No. 2
 Nose Vibration
 Axial Direction
 Random Qual
 Lead No. 4
 Overall Level = 30.5 G (RMS)
 100.6 $\frac{1}{2}$ Gs FULL SCALE
 Filter Bandwidth
 5Hz to 100Hz
 20Hz to 2KHz





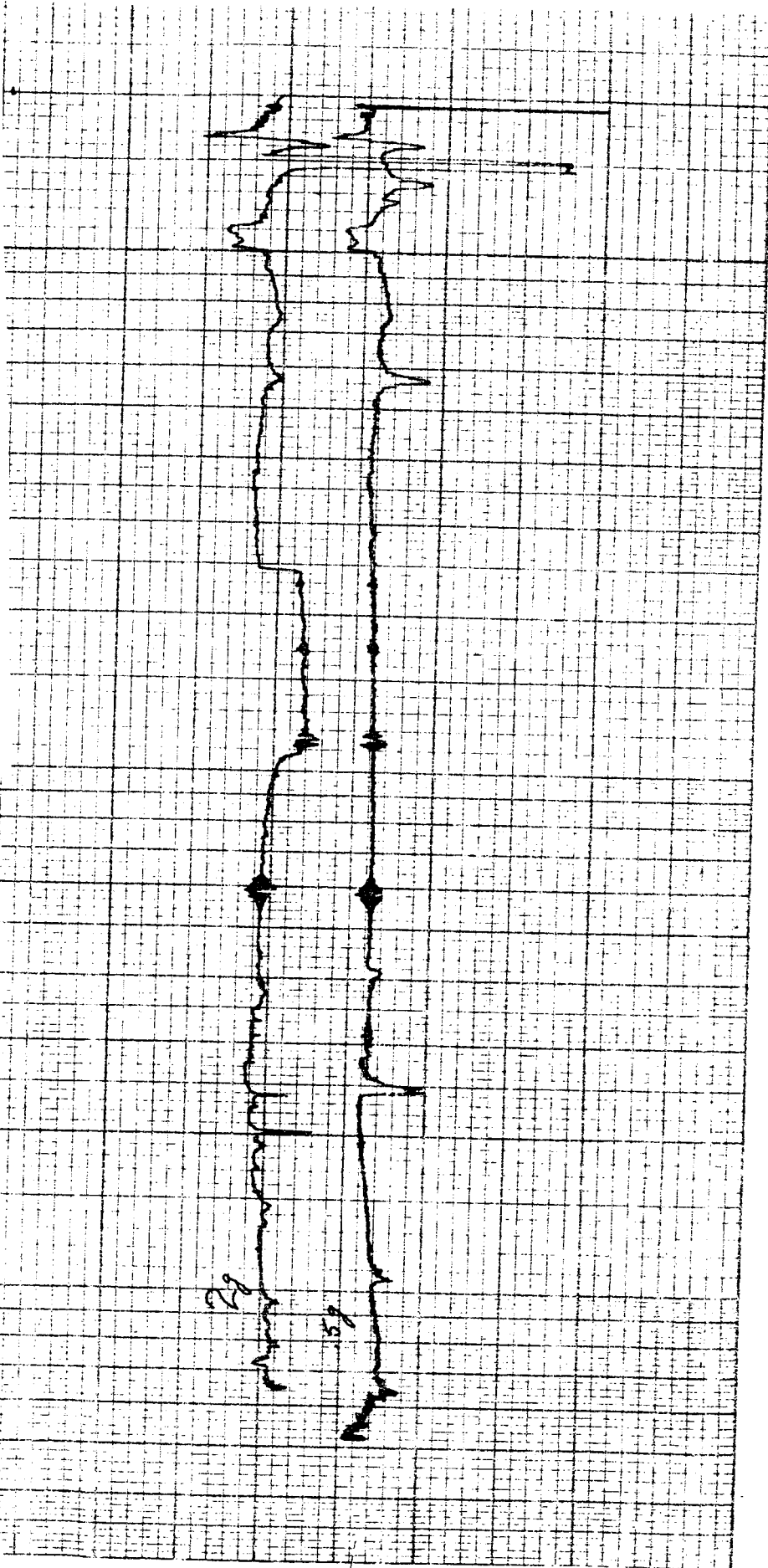
Tape Response Comparison

Output Wilcoxon M-127 Accelerometer

Accelerometer Glued to 3M Co.

Tedlar Tape

5/2/67



FREQUENCY - (CPS)

Tape Response Comparison

Input - Endevco 2213 Accelerometer

Accelerometer Bolted

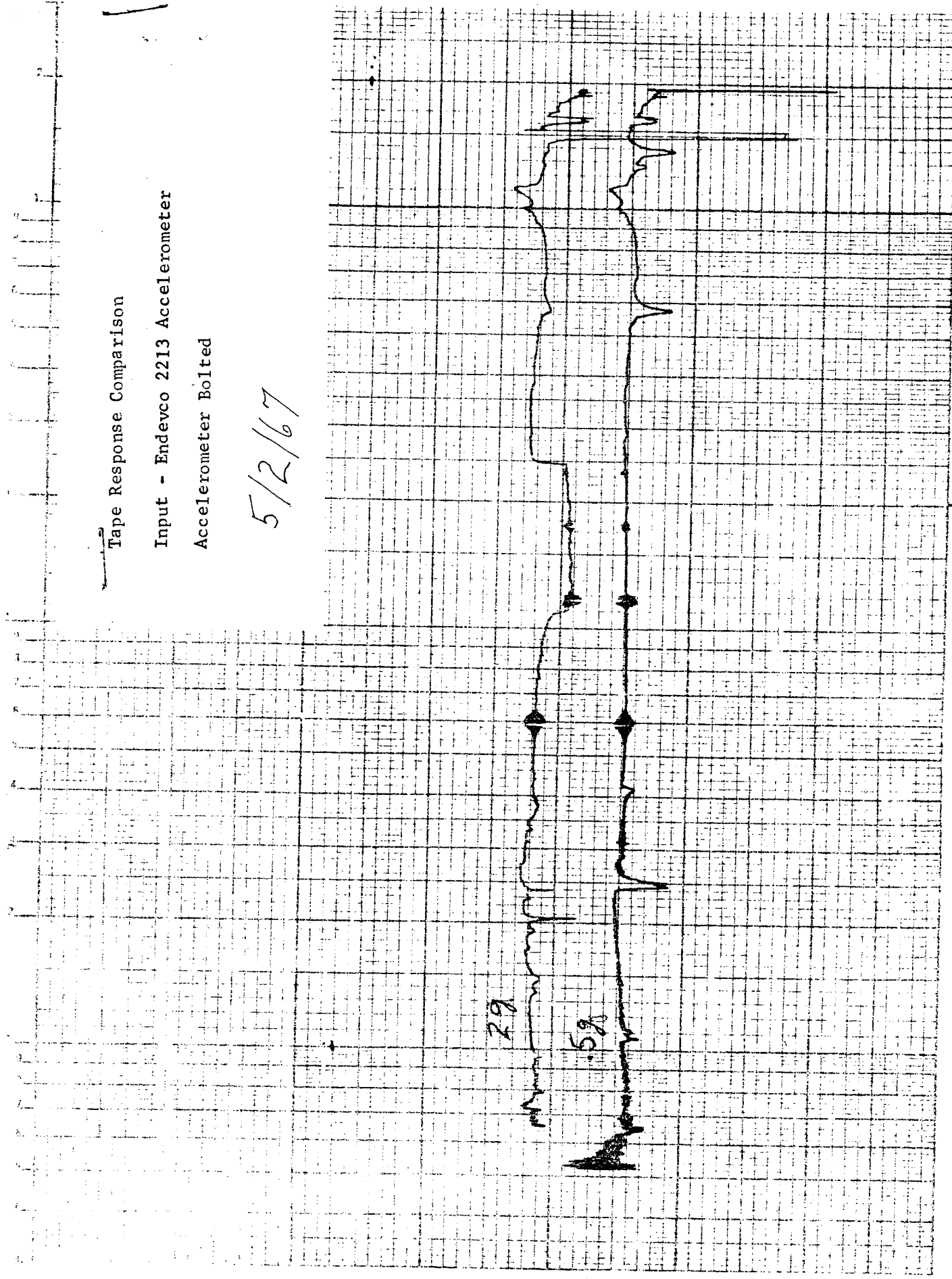
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ACCELERATION - G'S (O-P)

2g

5g

FREQUENCY - (CPS)



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